JOURNAL OF [illegible]

A RECORD OF THE [illegible]
AND THE ALL[illegible]

[illegible]

Charles [illegible], Ph.G.
Joseph W. [illegible], Ph.M. Sc.D.

[illegible]

VOL. [illegible] APRIL [illegible]

CONTENTS

Editorial:
The Light in the Window of Ebenezer ..... [illegible]

Original Articles:
[illegible] of Blood. By Prof. Griffith, [illegible]
Plant Pathology. By Prof. John Uri [illegible], Cincinnati, [illegible]
The Relation of Palm Oil [illegible]. By W. [illegible]
Dietrich, New York City ..... [illegible]
Introductory Address Delivered at [illegible]
Philadelphia College of Pharmacy [illegible]
[illegible] ..... [illegible]
Professional Ethics. By Dr. Joseph [illegible], Philadelphia. [illegible]

Association and Reprints Articles:
Pharmaceutical Ethics. By Dean Charles H. LaWall, Phila. [illegible]
The American Pharmaceutical Association. (Continued) [illegible]
Modern Ideas Respecting Ability [illegible]
[illegible] Candidate. From the Pharmaceutical Journal and Pharmacy [illegible]
in a Pharmacy (a Reply). From The [illegible] ..... [illegible]

Pharmaceutical Progress. [illegible] ..... [illegible]

Scientific and Pharmaceutical Miscellany ..... [illegible]

Editorial ..... [illegible]

News and Notes. [illegible] ..... [illegible]

The Endocrines, Digestive Ferments, Catgut Ligatures, etc.

THE ARMOUR LABORATORY is maintained for the purpose of handling the glands, membranes and other raw materials supplied by our abattoirs in immense quantities, from which important therapeutic agents are extracted and fabricated.

Among the products that the physicians and surgeons use daily are:

Corpus Luteum; Suprarenals, U. S. P.; Parathyroids; Pituitary, Whole Gland; Pituitary, Anterior; Pituitary, Posterior; and other glandular substances in po. and tabs. Pituitary Liquid in 1 c. c. and 1-2 c. c. ampoules. Suprarenalin Solution 1:1000; Suprarenalin Ointment 1:1000; Pepsin, U. S. P.; Pancreatin, U. S. P.; and other preparations of the Digestive Ferments that are used in stomachic and intestinal disorders and as vehicles for nauseating drugs.

We also make Sterile Surgical Catgut Ligatures, plain and chromic, boilable; and Iodized Ligatures, nonboilable. ¶ The Armour ligatures are made from Lambs' gut, selected especially for surgical purposes and sterilized at opportune stages in such manner as to preclude the possibility of contamination in the finished strings.

We are headquarters for the Organotherapeutic Agents and are always glad to co-operate with the medical profession

ARMOUR AND COMPANY

CHICAGO, U. S. A.

THE AMERICAN
JOURNAL OF PHARMACY

VOL. 94. APRIL, 1922. NO. 4.

EDITORIAL

THE LIGHT IN THE WINDOW AT EIMBECK.

To the traveler in the province of Hanover in Prussia, who is fortunate to come upon the quaint little settlement of Eimbeck, is pointed out the spot where not so many years ago an inquisitive apothecary unravelled the mysteries of opium and gave to the world the story of morphine, the first of the alkaloids. The apothecary, Friedrich Sertürner, so we are told, was not an overlearned man. He could write after his name no trail of dignified capitals, and his training in science had come to him not because it was forced upon him, but rather because he had yearned and struggled for it. His Gamaliel was Experiment and his University Experience. And yet, "unlettered, unsponsored and unread," he "opened the way to a vast domain of medical discoveries." Situate on a corner where alley met main street, this famous apothecary shop but looked the counterpart of scores of similar "concessioned" establishments in that province of Germany. Unpretentious and perhaps meager stocked but smiling with cleanliness and beaming the story of Frau Sertürner's neat custodianship, the little shop catered to the drugstore wants of a stolid community.

Out of Eimbeck no one knew or cared to know what went on inside its walls, and the townsfolk themselves cared but little so long as they could promptly get their herbs and simples when they needed them.

But somewhere back of the overvarnished and grotesquely carved partition the apothecary himself might be seen, early in the morning and very late at night, working by the fitful light of a malodorous whale oil lamp, puttering with muddy extracts and decoctions of strange Asiatic drugs. Crude was his equipment and meager his apparatus, but he worked on incessantly. He worked on and on un-

til the gossipy red-nosed men that lounged at the inn-front across the alley began to whisper forebodings of disaster to his well-established business. Frau Hohenlohe, an over-friendly neighbor, confided to Hausfrau Sertürner, as only women can, that the good *apotheke* was in danger of losing his concession unless he quit "playing with experiments" and tended better to business, for had he not one day kept the Colonel of Hussars waiting a half hour for a draught of *braus-pulver* while he, the *apotheke,* mussed about in inky vials of vile imported drugs torturing them with fire to seek their essence.

And so it was that the good housewife cautioned her partner to mend his ways and secured from him a promise, readily granted and as readily broken. For the next morn, so the story goes, before the sun had rubbed the cloudlets from its eyes, Sertürner was again at his beloved experiments seeking from the crude and dirty opium the essence that gave it its soothing virtues. A tinkling of heavy glassware, the bubbling of boiling extracts and the thumping of pestle in mortar broke harshly on the peaceful reveries of the morning hours and the half-awakened village blacksmith on his way to labor pointed in wonderment to the light in the dormered window of the *apotheke* shop, for here was a man who could but would not sleep even in the morning when sleep is sweetest. But the blacksmith little knew that the light of that dormered window would shine on into everlasting centuries and that the pathway of science would be greatly brightened by its penetrating beams.

For on that same morning borrowing a leaf from the book of the mathematical Greek, Sertürner aroused the neighbors with his joyous cries of *Eureka! Eureka!* and the discovery of morphine, long searched for by many and many a chemist, had become a fact.

Shortly afterwards (1806) Sertürner announced his discovery of *"opium-saure,"* later called meconic acid, and explained how it was combined in the drug with an alkaline base, which he called *"morphium."*

His report amazed the scientific world of that day and its importance was fully recognized when France later awarded to him a substantial monetary prize for "having opened the way to important medical discoveries by his isolation of morphine and his exposition of its character."

Thus it was that out of the modest apothecary shop in Eimbeck of Hanover, came the story of the first alkaloid, the herald of an

unending trail of like substances that have been since made known and utilized to the benefit of mankind. Sertürner had certainly "opened the way," and no better compliment than this can be paid to any worker in the ranks of science.

But today *They* tell us that no more epoch-making discoveries can be made by the untutored and plain. They tell us also that it is the day of the finished scholar, of the precisely trained, and that one can have no hope to reveal discoveries and attain inventions unless tedious and prescribed penance has been made at Gamaliel's feet. They say that the age of genius is past and the day of the college bred and college trained man is here. Truth today makes its nesting ground in the well-appointed laboratory and in the elaborate establishments of endowed institutes of research and only the anointed shall seek and find it there. The cradle of nature no longer holds it. But yet, when we seek into the story of yesterday, Archimedes was sequestering in a marble bathtub when he eurekaed upon the truth of relative density. Galileo was seeking solace from the noisy incantations of a tiresome priest by watching the swinging chandelier, and then it was that he evolved out of the phenomenon an understanding of some of nature's first principles. Isaac Newton found explanation of the law of gravitation in the laboratory of the apple orchard when an apple "obeyed that impulse" and letting go its scant hold on a twig landed squarely upon the dreamer's head. And we might mention many other similar giants of intellect and benefactors of posterity, untrained with slide and test tube, whose knowledge of calculus and trigonometry was microscopic and who paraded no alphabetical curlicues after their Christian or un-Christian names.

But our asserverations need no further corroboration. Archimedes, Galileo, Newton, Pasteur, Sertürner, Scheele, Procter, and a host of their kind come with us to state that prerequisites to the capacity to serve lie not in the over-emphasis of academic attainments but rather in the intuitive spirit of research born only in men who have the proper mental receptors and have inherited "the inner eye," which according to the poet is "the joy of solitude."

Imbued with this spirit are many men here and there over our land who lend no ear to the loud protestations of the university or college fanatic, but who toil on in apothecary shop, in foundry or out in nature's laboratory, eagerly searching for some new phase of old, old truths and anxious to interpret it to a waiting world.

The day of the genius is still here and ever will be here, and out of the orchard, the church, the home, the humble apothecary's shop shall doubtless come again many, many discoveries that shall have baffled the ken of men who have come out of the mills of the learned, but having eyes see not. I. G.

ORIGINAL PAPERS

ONE DROP OF BLOOD.*

By Ivor Griffith, Ph. M.†

The story of one drop of blood is the story of life. This is a story that has never yet been told. It is a story that man will never be able to tell. A physician of the old school once told a group of us open-mouthed youngsters of his Sunday school class that he was in fear lest some blundering scientific idiot should come upon the secret of life some day, and so bring upon the human race the wrath of a Creator whose most precious device and invention had been understood by a mere creation called man.

Physicians and scientists of the new and so-called advanced schools think not in this respect, for in our newspapers of a few days ago we read of a man named Carrel who in his search for this philosopher's stone, has known how to keep a fragment of a chicken embryonic heart growing and thriving in an artificial atmosphere. Alexis Carrel, this wonderful man of science, is quite able with his invigorating and life-sustaining media, to cause this fragment of embryonic tissue to add cell after cell to its structure, and so rapidly that daily portions must needs be dissected off, so that the tissue growth does not overflow its container. But each cell that divides and gives two to the tissue, only adds to Carrel's dilemma.

As the cells multiply, so do the troubles of Carrel, and the distance to a discernment of the secret of life becomes proportionately further. The secret of life lies not in its promotion and further-

*One of a series of Popular Lectures, given at the Philadelphia College of Pharmacy and Science.

†Department of Theoretical Pharmacy, Philadelphia College of Pharmacy and Science.

ance and sustenance, but rather in its origin. Whence comes this subtle thing called life—not what is Death's antidote? Our old physician Sunday school preceptor was old-fashioned enough to teach us that this latter has been man's to own since a gray morning in Nazareth.

And so we say that the story of life is the story of a drop of blood, yea the story of one blood cell. Thus do we also apologize for the seeming disconnection of our presentation and for its incompleteness.

To present a subject such as this popularly, we are told that we must sacrifice cold scientific facts, and offer instead a collection of easily digested and tastier morsels. To refrain, as it were, from the meat of the subject and serve the less nutritious but more salubrious and assimilable delicatessen. And so to the front counter.

In order to have some semblance of regularity to our discourse we ask you to accept these landmarks and to allow us thus to divide your consideration of this topic:

Physical characteristics.
Chemical characteristics.
Microscopic characteristics.

We also ask you to consider the blood of which we speak as human blood, unless otherwise stated.

Like every good preacher, we faithfully expect to wander from our text with regularity, and carry you with us to fields quite remote from these infenced pastures. We speak of one drop of blood in the title. It is of blood regardless of volume that we speak throughout the lecture. What does the dictionary say of blood? "Blood is the fluid which circulates in the arteries and veins of an animal." So answers one with brevity and conciseness. But what of its nature and its functions?

Blood is a tissue, an organ of the body, quite as distinct as the liver or the heart or a muscle. It is a wandering tissue so important to the economy that it can never stay long in one place, but must unceasingly travel through its sinewy canals to perform its endless obligations. It is the most vital tissue in the body.

The blood is the military establishment of the Kingdom of Animal. And it is a military establishment that is perfect in every

detail as long as health rules. The realm of Wilhelm with its military perfection boasted of no system such as we have in this fluid army.

Consider it a while. Its purely defensive and aggressive organization. Its Militia, its National Guard, its Home-Defense Corps—the hosts of white cells ever ready for attack. Its Service of Supply—the red cells everlastingly carrying the oxygenated munitions and the simplified protein molecules to the organs needing them, and conveying back the unwholesome gaseous material that the tissues wish to be rid of.

The Quartermaster's Department—the serum with its hidden hormones, its endless enzymes, its aggressive agglutins, its limpid lysins, its opened-eyed opsonins, its fighting antitoxins—ever ready to deliver these agencies wherever needed. Its Intelligence Department, so reliable that a pin prick on the finger tip is sufficient impulse to have a detail of leukocytic scouts there in two minutes, to survey the ground and offer resistance to infection if necessary.

The Sanitary Corps—the serum again that conducts to the kidneys and thence to excretion—the various poisons and wastes that are eliminated by tired organs, and by over-exercised muscles. Its Medical Department with its commissioned Pharmacy Corps that is always responsive to emergency. Let the liver get torpid and sluggish through its owner's indiscretions, and the message is carried on a trunk nerve to headquarters. Comes a call for calomel. Ten one-tenths and into the stomach it goes, to find the first aid department of the blood stream ready to convey it while the pharmacy corps prepares it, so that by the time it reaches the torpid liver it is in the precise form for the exercise of its duties.

Then again its Engineering Corps. A staphylococcus with an impertinent turn of mind alights on a professor's collar. The collar made by Dupont is too slippery to suit it, so the naughty germ jumps over to the skin on the back of the neck. Now the staphylococcus is a mean germ, and its meanness is accentuated by its multiplication factor. Given one staphylococcus in a suitable environment, and by the next day the one becomes a million. Now this particular staphylococcus on the professor's neck ambles over to an intracellular air space and proceeds therewith to multiply. With its multiplication comes arrogance and it becomes conceited enough to establish a permanent home for old and indigent staphylococci. For

once the intelligence department of the blood has been derelict in its responsibilities, and before a message of succor reaches the commander of the white cell army, the staphylococci have been able to entrench themselves securely, and to offer formidable opposition. But at last the battle summons reaches the white cell host, and from every direction they stream in endless array to the conflict. The battle of the Boil begins in earnest, and the patient professor suffers in agony while the turmoil of war goes on unceasingly.

Here, perhaps, a squadron of germs hard presses a battalion of white cells, but on the left the bugs are falling back and the phagocytic cells wreck havoc among them. The tide of battle sways. Meantime the boil, so called, swells and matures to a livid yellow mountain, and the professor wears a silken collar. No chemistry for the boys today, and the boys, as boys will, wish luck to the pestiferous parasites.

But wait, what goes on beyond the field of battle? Why is it confined to the neck—that body Belgium? Ah! but what of that engineering corps of the fighting blood. Back of the field of battle they are there valiantly working, and their allotted task is the building of a wall which shall confine the onslaught to a certain area and stay its poisons out of the body proper. If the white cell engineers succeed in building the fort, the blood stream keeps wholesome and uncontaminated. If the engineering corps fails in its work, there comes what we call Blood Poison. The germs victoriously enter the sacred system and through the portals of bacteremia, septicemia and pyemia comes the dreaded spectre of Death and Dissolution. But happily this is very seldom the case for the Engineering Corps is usually very efficient. The abscess is completely walled off, and the staphylococcic host is denied its sustenance, starvation and decimation thin their serried ranks, the boil bursts, a tribute to the ingenuity of the sappers and miners of the blood stream. I'll grant you that in this terrific battle much sacrifice is made, for millions upon millions of the killed white cells are the penalty which the body pays for its safety. The bursting of the boil is the signal of victory. Presently this staphylococcic Waterloo is only marred with a ragged scar, and the neck once more enjoys the placidness and peace that knows only the disturbance of a crinkled wash rag or a serrate linen collar. The beloved professor once more faces his class and without a rigid neck.

Thus it is that the manifold duties of this martial tissue of the Kingdom of Animal keep it ever on the alert. Even in days of peace do we find the corps of engineers busy. An accident befalls the host. A finger or a hand is amputated. Blood canals are severed from the body, and who shall build new channels for the fluid's passage? The hand is amputated at the wrist. And will the severed artery spout blood and impoverish the system and bring it to its destruction? No, for the surgeon ligates the veins and arteries, seals their end as it were. But this does not, we must remember, make for circulation. So promptly the engineers of the blood, the physiologist's wandering cells, commence to build communications so that the network of military routes shall be re-established and that the nourishment of the stump may be sustained and made accessible to the throbbing stream of blood. The surgeons and anatomists call this anastomosis. We call it an engineering feat. Emergency pontoons so constructed that they last a lifetime.

How seldom we pause to give thought to some of the processes which daily occur in our lives. How little we seek to know of the pleasure that comes with understanding something of these commonplace things of life. A fairly deep cut into our flesh, and out gushes the crimson stream. But promptly the gush modifies to an ooze, and almost unnoticed the dripping ceases and the cut is tightly soldered. Why did not the flow continue, and what providential agent came to stop the leak? It is the plumbers of the blood stream, who, for plumbers, are fairly prompt and seldom fail to come when we call them. And also the plumbers of the blood stream never have to go back home for forgotten tools.

There are a few unfortunates, however, in whom the plumbers are lacking. Such persons are known as hemophiliacs, and are dangerous operative risks. The mechanism of coagulation is not definitely known although certain hypothetical theories are generally accepted. Most prominent is that of Jules Bordet, who states that elements from the blood serum, which he collectively calls serozyme, as well as from the cells and platelets which he denominates cytozyme, unite to form a substance called thrombin, which in turn unites with the fibrinogen of the plasma to form fibrin or the clot. Contact of the blood cells with tissue walls and the presence of calcium hastens the union of the serozyme and cytozyme to form the thrombin. Coagulation normally occurs in four to eight min-

utes. Clotting is more rapid where pressure is exerted on the puncture or cut, so that the technician in testing for this factor must avoid any undue pressure but rather let the blood flow of its own accord. This is also why some workers prefer to withdraw blood directly from the vein instead of by puncture.

There are certain artificial blood coagulants that promote clotting of the blood. Chief among these is the kephalin type, usually a tissue extract (calves' brains).

The determination of the coagulation time of blood is part of laboratory procedure, and is done in many ways, none of them accurate in the strict sense of the word. Sufferers from jaundice show a high coagulation time. For certain purposes, notably in blood chemistry, it is desirable to prevent blood clotting *in vitro*. This may be accomplished by directly receiving the blood into a 1 per cent. solution of sodium citrate or fluoride, powdered or dissolved oxalates. The chemistry involved here is that these substances precipitate and render inert the calcium salts which are so essential to coagulation.

The average healthy adult carries on his or her person quite a burden of blood. This tissue represents approximately one-twelfth to one-fourteenth the weight of the body. Blood volume varies, however, even in health, and that is one reason why hematological laboratory findings are never actually reliable unless calculated from the arbitrary cubic millimeter unit to the actual volume content, which is obtainable by certain physical methods. However, for usual clinical observation blood volume is disregarded. Thus a person weighing 120 to 140 pounds has a blood content of about ten pints or as much blood as might be contained in five quart milk bottles; rather a formidable figure when we think of it in this way. With this knowledge we must bear in mind that when we desire to emphasize the seriousness of an operation a la Irvin Cobb, we must no longer quote the doctor's "Oh, you lost a whole pint of blood," but rather let us say: "Dear me, I lost almost a gallon of blood." That sounds more like a hospital anyway.

Also we need not disbelieve the blood donor who boasts of having furnished at odd times and for adequate compensation a pint or two of blood for transfusion to an anæmic patient.

Incidentally let me make you acquainted with a new American profession—namely that of the peripatetic donor of blood. He is the

man, generally in his twenties, when the ratio between blood and sense is at its ebb, who leaves his name and address with every hospital laboratory, who will furnish for transfusion a pint or a quart of blood once every two weeks. This may seem unbelievable, but we know of many such persons who render this service quite regularly for a time, and so obtain their living. Moreover it has been our observation that this continuous depletion of the stream of vitality always leaves its impress behind on the donor, or rather the seller of blood. For although nature replenishes the quantity of blood each time the blood is used, it is well known that the quality of the blood is impoverished in a great many respects.

I have refrained from mentioning the fact that transfusion of blood from one person to another is not to be done empirically for the reason that incompatibility may exist between donor and recipient. Preliminary tests are made on both in order to establish their types and to preclude the possibility of mixing inharmonious bloods. The nature of these tests, and the various theories in regard to grouping bloods are too broad and far-reaching to be discussed here.

Physically blood is composed of four types of basic elements held in suspension in a liquid called the blood plasma. These four form elements are the red corpuscles (which the pedantic call erythrocytes), the white corpuscles called leukocytes, the blood platelets and the so-called blood dust or hæmoconien. These substances represent from 40 to 60 per cent. by weight of healthy human blood, and the serum or plasma represents the rest.

Ordinarily blood is a dark, red opaque fluid due to the red corpuscles. Through the action of certain agents, however, it may be rendered transparent. Water, ether, and certain bacteria are capable of doing this, and blood so altered was formerly said to be laked. Now we use a more high-sounding term, namely hemolysis, and the agents are said to be hæmolytic agents.

Hemolysis simply means a disruption of the red cells with the liberation of the pigment hemoglobin which they contain.

The specific gravity of blood varies between 1.045 and 1.075. This may account for the old line that blood is thicker than water. Oddly enough it varies with sex, the blood of males having a higher density than the blood of females of the same species. In sickness

this factor often changes to a marked extent, and according to the poets with advancing age, for Shakespeare says that

"The hairs on his brow were silver white,
And his *blood was thin and old.*"

Although correctly this really refers more to viscosity than specific gravity.

The reaction of the blood, formerly held to be distinctly alkaline is now stated to be neutral, with an infinitesimal leaning to the alkaline side. And this only because the combining power for acids is greater than it is for alkalies. One authority states that, "Our blood has a remarkable capacity to preserve its normal slight degree of alkalinity, to escape at the same time the *Scylla* of hyperacidity and the *Charybdis* of excessive alkalinity. This wonderful capacity for self-adjustment and preservation of its optimum conditions for the purposes of life is a typical instance of the innumerable fine mechanisms of self-adjustment in the body, all aimed at maintaining the most favorable environment for the functioning and preservation of life—self-adjusting mechanisms which in fact comprise for the scientific investigator the most impressive points of difference between living organisms and the lifeless world. And yet this remarkable power of the blood to maintain its normal alkalinity has been elucidated in a very complete way (especially by L. Henderson, of Harvard University) by the application of simple principles of physical chemistry to the study of the composition of the blood: There are chemical 'buffers' present, which act chemically to preserve neutrality exactly as powerful springs act as mechanical buffers to minimize the shock of impact to fast moving bodies."

Blood serum, or the liquid portion which separates when blood is allowed to stand, contains a number of complex organic substances as well as a few inorganic salts. These substances consist of almost 8 per cent. of its weight. Of the organic substances fibrinogen, referred to under coagulation, is the most important; and of the inorganic sodium chloride, sodium bicarbonate and certain phosphates are the most important. These salts are very important elements in the make-up of the blood, and play pivotal positions in the functionating of that tissue. For instance, were it not for them the corpuscular elements would swell and disrupt.

Their function as buffer substances in regulating the reaction of the blood is fairly well known today, although there is much

about this mechanism that is not known. May I suggest rather a far-fetched query at this time just to show how peculiarly the blood enters into the body working? Why do we puff after strenuous exercise? Here is the accepted answer. The respiratory centre (the lungs, etc.) is extremely sensitive to the minutest alteration in the reaction of the blood toward the acid side. Now muscular exercise produces in the blood and tissue a slight increase of carbon dioxide, which is acid in its nature. Increased ventilation of the lungs, however, removes this carbon dioxide, thereby bringing the reaction of the blood back to normal. Increased ventilation is simply another name for puffing. There is much more that could be said about these peculiar and interesting blood functions, but it would only be at the expense of overlooking some facts which may be more basic and elemental.

As was stated the color of normal blood is due to presence of hemoglobin in the red cells. In arterial blood this albuminous substance is in combination with oxygen and is here termed oxyhæmoglobin, hence the scarlet blood of the arteries. In the venous blood there is both hemoglobin and oxyhæmoglobin, this accounting for the bluish color of venous blood. Blood color changes with certain diseases, such as scurvy, etc., but more so in the wake of poisonous substances. Coal gas or illuminating gas containing carbon monoxide changes the color to a vivid red due to the formation of carbo-oxyhæmoglobin.

With potassium chlorate, aniline, hydrocyanic acid and certain other agents the color becomes a murky red to a chocolate. Certain of the coal tar derivatives also possess the power of destroying the red blood corpuscles. This accounts for the livid color of headache powder dopes, and acetanilide habitués. In extreme cases of leukemia it becomes milky, due to the presence of a vastly increased amount of white cells. Of hemoglobin we shall have more to state later on.

Of the chemical aspects of blood the medico-legal aspect is probably the most interesting. The decision in many a murder mystery has hinged upon the positive identification of blood stains. These forensic problems are particularly difficult to solve where a stubborn jury is to be convinced that the blood stain upon the axe or the hatchet or hat pin or what not is human blood and not animal blood. Annals of the courts often record such cases. In a Camden court some time ago, we are told that such a case was tried, and the

prosecution for safety's sake had brought to court all of the chemical paraphernalia surrounded by a chemist, so that the jury could be shown and be convinced that the stains in question actually were human and not goat blood as the defense claimed. Unfortunately the chemist being human, could not stand the concentrated stare of a dozen jabbering Jersey jurists and in his excitement he got things a bit mixed, so that the outcome of the test apparently proved that the stains were neither human nor goat blood. The case was thrown out of the court—so was the chemist. But of course strange things do happen in Camden.

Another story recently appearing in a fiction magazine, tells how a murderer's identity as an Australian was established by the ability of a physiologic chemist to prove that certain stains upon the handle of the murder weapon were kangaroo blood, and the blade stains were human or the victim's blood.

Of the forensic tests for establishing the identity of human blood the most certain is probably the physiological precipitation test. This test is based upon a fact well established in serum pathology. It has been proven that the serum of an animal injected with blood or blood serum of another animal, shows the property when added to an homologous serum of precipitating the protein of this serum as a light, feathery precipitate. This is a specific reaction indirectly similar to the Wassermann test. Thus if we inject a rabbit with human blood at certain intervals, the serum from the blood of the rabbit will afterwards have the property of precipitating the albumin from a suspension or solution of human blood, and will not precipitate goat's, camel's, or other blood. The one fallacy (and let Darwin disciples in the audience gloat over this) is that the blood of anthropoid apes acts exactly the same as human blood. However, that element may be usually excluded, and the law now recognizes this test when positive, as reliable in differentiating human blood from that of domestic animals. Strictly chemical tests, but not at all specific, are the guaiac or benzidine tests, which are used as routine tests in the laboratory for the detection of occult blood.

Another test, known as the Teichmann test, which has for its end result the separation of hæmin crystals from the blood. The spectrosrcope is often used in the detection of blood, but its value is limited. While we have not carefully considered the chemical

aspect of blood we must not pass by without mentioning one blood constituent that has ever been the hallelujah chorus of the patent medicine man, and the oft recurring sing song of the nervous thin-blooded patient. We refer to iron. Witness the pages of a Philadelphia newspaper which nearly everybody reads, and in huge captions a quack medicine advertisement advises us when weak and run down to eat a certain brand of iron pills, the same identical brand that Willard fed upon when he floored Jack Johnson. Oddly enough, when Dempsey later floored Willard, the advertisement gave Dempsey credit for eating their pills. Then again comes a California group of fruit growers with the startling discovery that it is the iron in raisins that make them worth while as a tonic, and the suburbanite is glad to find a logical pretext for carrying home the five pounds of raisins for which his formulas call.

As a matter of fact there is very little iron present in the entire blood volume. One might approximately state that there is just about sufficient iron to constitute the bulk of two small carpet tacks (or about 35 grains).

This does not infer, however, that a diet of tacks would be in any way beneficial, although except for traumatic considerations, it is quite conceivable that the self-diagnosed anæmic person would benefit quite as much by swallowing the tacks as by swallowing a bucket full of some of the patent forms of iron sold as blood purifiers and builders. When the blood needs iron, and it sometimes does, the best way to bring the two together is now alleged to be by the hypodermic injection of assimilable iron compounds. It is known, however, that certain forms of iron taken into the stomach act favorably on general blood characteristics. As a matter of fact in chlorosis the administration of iron affords one of the most brilliant examples of the specific action of a medicine. More recently Germanium oxide has been advanced as a hæmogenetic and is alleged to be far superior to iron and arsenic in that respect.

The microscopic characteristics of blood are diversified but well studied. As previously stated there may be seen in blood when examined under the microscope four form elements, the most important being the red cells and the white cells. Each cubic millimeter of a healthy man's blood normally contains about five millions of the red cells and about four and one-half millions for the same unit of a woman's blood, and about five to seven thousand of the

white cells. This means that one drop of a healthy man's blood contains about 300 millions of the red cells. Not to be outdone by our city statistician we are venturing further to state that a healthy adult contains in his whole blood stream twenty-five thousand billions of these little cells. Following along conventional lines we further state that if these little cells from one man's blood were arranged side by side, microscopic as they are, they would constitute a ribbon that would completely encircle the earth and still leave enough to tie a handsome bow. There are, of course, variations from these figures that are normal. And again there are variations that indicate morbidity. Thus we have in phosphorus poisoning counts as high as eight to nine million red cells and in pernicious anæmia counts as low as half a million. Persons living at high altitudes likewise show abnormally high red blood counts. In the Cordilleras we are told that the natives show counts of eight millions per cmm.

The red cells of human blood are circular, biconcave discs about one-three-thousandths of an inch in diameter and about one-twenty-five-thousandths of an inch in thickness. In infancy larger and smaller forms are found even in health, but in the adult the predominant characteristic of the erythrocytes is the persistent uniformity of shape and size. Departure from this uniformity indicates morbidity.

The peculiar biconcave shape of the red cell has never been satisfactorily accounted for. Physiologists differ as to the source of origin of the red cell in fœtal life, but during the period of growth and adult life they are agreed that the cells are developed from nucleated cells called erythroblasts, which are formed in the marrow of the bones. These blasts multiply by a process called karyokinesis and gradually become changed, with the vanishing of the nucleus, into the red cells. Thus it is after a hemorrhage or when the blood is regenerating, that we find some of these nucleated red cells in the blood picture and this is to be interpreted as a favorable sign. The period of life of the red blood cell is said to be about three or four weeks, so that we may assume that there is a continuous regeneration of these cells going on in the healthy blood stream. And we may also state that the grave of the red cell is the liver, so that its gay career starts in the marrow and ends in the liver.

Blood regeneration after a hemorrhage is very prompt. Even after a severe loss of blood in man, Lyon found that in three weeks' time restoration was complete. The erythrocyte owes its color to hemoglobin and oxygenated hemoglobin. Hemoglobin belongs to a class of bodies known as chromo-proteins and because of its ability to combine loosely with certain gases, thus promoting the gaseous exchange of the body, it is styled a respiratory protein. It is the iron in hemoglobin which enables this pigment to exert its vital power of oxygen transference. Normally human blood contains about 14 per cent. of this pigment. Actually the figure upon which computations of hemoglobin blood content is based is 13.77 of hemoglobin per 100 cc. of blood. This figure is arbitrarily termed 100 per cent. hemoglobin and the standard hemoglobinometers such as the Sahli are computed to this unit.

Pale or colorless complexioned people frequently but not always lack this pigment as well as the red cells, athough we frequenty find that the cells may be present but with the pigment lacking. In chlorosis, for instance, each cell shows less hemoglobin than normally, although the number of cells may be normal. In pernicious anæmia, on the other hand, the cell content of pigment may be very high, but with a low cell count. Thus it is that the laboratory examination of hemoglobin is an important part of the hematologist's work, and an important aid in establishing diagnoses.

The main function of the red cell as we have previously stated is to promote the gaseous exchange in the body—to carry away the noxious gases and to bring back the life-giving oxygen. The white cells or the leukocytes are the fighting soldiers of the blood stream. There are several types of white cells, all nucleated, and they may be generally classified into two groups, the one where granulations are present in the protoplasm and the other where no such granulations exist. Further classification is made according to the peculiar affinity which the granules may show toward certain acid and basic aniline dyes. Normally the blood contains about one white cell to each 1000 red cells. In disease the ratio changes usually with an increase in the white cell count. Thus it has been noted that in cases of pneumonia ending in recovery, the blood generally contains a greatly increased number of leukocytes, while in fatal cases the white cells were in normal number. This fact was particularly noted during that famous, or shall we say infamous, epidemic of flu.

It is for this reason that enumeration of the white corpuscles of the blood is now a potent factor in the diagnosis of disease. In appendicitis, for instance, the white cells increase three or fourfold and particularly so if that unloved and unwanted part of the anatomy is flirting with an abscess. The absolute count as well as the differential counting of the leukocytes is the common routine procedure with every hospital patient in these hectic days of laboratory diagnosis, and we sometimes feel that the tube and the slide has almost entirely replaced the mind and the eye of our good friend the doctor.

The white cell possesses amœboid motion, which the red cell does not, although the latter does possess some molecular motion. The white cell is also frequently phagocytic, that is it has the power, happily for us, of destroying bacteria by encircling and cannibalizing them. Not only that, but we are told that blood invading bacteria become weakened in their vitality just at the sight of a white cell, that is before phagocytosis begins. This may be demonstrated in a most interesting fashion under the microscope. There is a comely parasite to which the scientists give the following abbreviated designation, Hemogegarina stephanovi. This parasite has a peculiar nonchalant gait when it traverses familiar by-paths, and fortunately for us its habitat is in the blood of reptiles and not in the blood of man. But when it invades the blood stream, and happens to step in the road of a trouble-seeking white cell, it gets languid and loses its familiar confidence. Just as soon as the leukocyte comes to its field of vision, it becomes stiff and stretches out, scared stiff as it were. After a few seconds large vacuoles appear in its nucleus. The white cell at once sets to work to surround its victim, and five minutes after the accidental meeting, our friend the parasite has been completely englobed by the leukocyte. This phagocytic index, or the capacity of the white cell to consume germs, is now measured in the laboratory so that we can definitely establish a patient's power of resisting or overcoming infection by counting the average number of certain bacteria phagocyted by the polymorphonuclear white cells.

A word in regard to the blood platelets. The significance of this element is still in doubt. They have long been known, however, to have some bearing on coagulation, and are the only elements whose disintegration is to be seen in the coagulation of normal blood. When

coagulation is observed under the microscope the fibrin strands are seen to start from groups of the platelets.

The blood dust of Müller (hæmoconien) consists of fine granules which have a vibrating motion. Little is known of them and they are given scant consideration in clinical blood examinations. The suggestion has been made that they are granules from disintegrated white cells.

Of the lymph or plasma we hesitate to speak since there is so much to say and so little time in which to say it. There is after all but very little known about blood functions that seem to reside in the serum or plasma. Empirically we think our information is considerable, scientifically it is very scarce. When after exposure to infection the first line of defense wavers and the infectious agent creeps progressively onward, when the barriers of the second line are broken through and a complete invasion of the blood stream is threatened, what then? Host after host of white cells pour in mighty cavalcades and valiantly fight the invader of their homeland. But the toxemia induced by the bacterial invader may be so intense as to overwhelm the white cell army, and what then? Out of a mystic somewhere in the plasma flows a magic fluid that paralyzes, precipitates, dissolves, agglutinates or otherwise disarms the intruder. Scientists call these special properties and constituents of the serum, agglutinins, precipitins, bacteriolysins, antitoxins, etc., knowing them at least by their deeds even if unable to identify them as separate entities.

Sometimes, of course, even this last line of defense is insufficient to curb the progress of disease, and the human organism is forced to succumb and to be conquered, and the penalty of conquest, and complete conquest, generally spells death. However, it is not uncommon to have an infected blood that stays infected through life and death comes in another form. Malaria or syphilis, both parasitic diseases of the blood stream, are not promptly fatal, although they would prove so unless actively combated with outside agents.

Those of you who are initiated will doubtless query my avoidance of considering the purely chemical aspect of blood, and wonder why, at a time when blood chemistry counts so much, that so little attention has been paid to it in this presentation. My reaction to this query is that consideration of this complicated factor of blood

analysis is much too detailed and technical to afford of its discussion in as elemental a treatise as this. Reference can be made, however, to the fact that the physiologist of today pays far more attention to the chemical qualities and constituents of blood than ever before. Time was when urinalysis comprised the major diagnostic assistance that the laboratory offered the clinician. Albumin or sugar in the urine constituted the greatest contribution along quantitative lines that the chemist had to give to the diagnostician. Today, however, more attention is paid to the analysis of the blood than to the analysis of the urine; and it is a well-established fact that more definite information may be thus obtained.

For instance, is it not far more important for the doctor to know how much sugar is being retained in the blood serum rather than to know how much is being eliminated by the kidneys? For after all it is the noxious substances held inside the kidney threshold that inure to more body hardship than do the noxious substances that are passed out of the body. And so we have today in the laboratory, accurate colorimetric and microcolorimetric tests which tell us just how much sugar there may be in an arbitrary unit of whole blood; or just how much urea, uric acid, creatinin, nonprotein nitrogen, dissolved gases, etc. And these tests are so accurate and delicate that the careful diagnostician can by these means gauge his patient's actual blood condition to a nicety.

Likewise in the field of serology much progress has been made. The Wassermann test for syphilis; the Aberhalden tests, the complement fixation tests for Neisserian and tubercular infection, the Widal and other agglutinating reactions are marvellous examples of the trail of success along such lines of blood search and research.

Then again the various methods pursued for determining by culture and otherwise the presence of organisms in the blood stream. How wonderful has been the romance of the development of some of these tests. Not the work of one genius alone, but the correlated and dovetailed results of the painstaking investigations of a hundred plodding workers in this altruistic field of endeavor.

Let me just skim over the reagents used in the conduct of the best known of these tests, namely the Wassermann test. For the manipulation of this one test alone the laboratory worker uses these several reagents:

The red cells from the fresh blood of a sheep.
The serum from the fresh blood of a guinea pig.
The inactivated blood serum of the suspected patient.
An alcoholic extract of the heart of a guinea pig or cow.
An extract of the liver of a syphilitic fœtus.
The blood serum of a white rabbit sensitized to sheep cells.
Human blood serum that is known to be negative.
Human blood serum that is known to be positive.

And to handle these accurately standardized reagents must be granted a patient and a willing and thoroughly conscientious worker, who must at all times realize the need for honest and accurate service.

A brief resume of some of the diseases which infect the blood stream, and some known antagonists might add to the interest of this rather disconnected and garbled paper, but that is possibly a topic that can made the subject of a future lecture.

PLANT PHARMACY.*

By John Uri Lloyd.

May I speak informally on one of the many phases of plant pharmacy? This is an extensive subject, a mighty problem, and I would suggest the consideration of but a restricted thought rather than an attempt to review the field as a whole. Let us begin by means of an argument which by some persons may be considered an excuse or an apology for audacity in what I may afterward express. Turn to your works of authoritative lore, behold, what I have to say may not be found in connection with our subject, nor, perhaps, with any other.

Any opinion contrary to expressed or voiced "authority" is by some people considered heterodoxy, akin to scientific agnosticism. But we are "irregulars." An ostracized people, a minority section in medicine. But by this very fact I hope are liberated from phases

*Informal remarks made at the 1909 meeting of Eclectic Medical Society of the State of New York. Fragment of early lecture delivered in the Eclectic Medical Institute, Cincinnati, 1879, connected with article, "The Ocean of Vitality and Reservoir of Life." This Journal, January, 1922. Permission to publish in a medical journal granted.

of mental bondage forbidden him bound by the code of ethics that restricts mental expansion. We believe we have the right to walk into fields hitherto untrodden, to think, to reason, to expound theories new and strange and proclaim reasons for our opinions, be they what they may. No man can to us say, "I am authority," and by that self-sufficient assertion deny others the right to individual thought. No one, in our opinion, has reached infinity of thought. This privilege I hold as a pharmacist.

The pharmacist of the future, this speaker believes, will stand above our heads, he will see clearly what we have never seen, grasp things we have never touched. Deplorable would it be to reason otherwise. To accomplish this, irregularity of the present must become regularity. And, it *must do so* or pharmacy will either expire of inaction, or be shattered into fragments by the encroachments of invading sciences. Let us, with this audacious assertion in mind, consider some features of the subject, "Plants in Pharmacy."

Comes to thought, as an introduction, what is a plant? And next, what is an animal? What relation exists between the pharmacy of the plant and that of an animal? According to general acceptation, if not the dictionary definition, a plant is a vegetable, "a vitalized structure endowed with life." A living structure, but yet devoid of voluntary motion; devoid of true sense perception may also be applied. To pass further, a scientist might say, plants inhale carbonic acid and exhale oxygen, animals reverse the process.

Let us next consider a typical plant—for example, a tree. There are varieties of trees, ranging from tall trees with mighty trunks to treelike shrubs, in untold number of grades. These may be bushy or slender, drooping like the beech, or tufted like the cocoanut. There are trees with smooth bark, as the birch, and trees whose bark is rough or coarse, as the hemlock, or shaggy, as the hickory. Barks vary to infinity. We cannot define the tree by any one feature involved in descriptions such as these, nor yet by the leaf. For example, the leaves of some trees are single, while the leaves of other trees are compound in tufts; some leaves are smooth, others rough; some leaves exhale one odor, others another, while yet others are odorless.

The tree, be it large or small, is, however, only one form of plant. There are herbaceous plants and woody plants. There are land plants and marine plants. There are even cannibal plants, like

the pitcher plant or the Venus' fly-trap; marvelously do they seem to approach sense perception. The mistletoe, that grows from the bark of the oak or honey locust tree, is typical of vegetable vampires. Many a delicate vine creeps up a tree-support, and finally in ingratitude squeezes the life out of its friendly helper. There are plants that grow in air and have no roots, and others, like the fungi, have no leaves.

Nor, in describing vegetation, can we truly say that a plant has no power of voluntary motion, or yet that it is wholly devoid of a something akin to intelligence. What causes the shrinking, and even the coiling up of some leaves when struck or even touched, as does the leaf of drosera? Habit, may be the reply. Why do some vines twine to the right, others to the left? Why does the clematis, destitute of tendrils, twine its leaf stalk around its support and thus hold itself up? If habit is the answer, one might ask, "What is habit?"

Bring together all the functions of plant and animal, correlate them, and see if you can with satisfaction to yourself draw a clear line separating the animal from the plant. Rather is the link series not like a continuous chain, animals at one end, plants at the other, the lower orders of the two (regardless of micro-organizations) so closely allied in some of their functions as to merge, as does sanity into insanity?

Let us ask, what is plant pharmacy? Superficially it may be defined as the study of plant structures used in medicine, and of the preparations made therefrom. But, although we relegate the term to ourselves, can the apothecary who makes preparations of plants say, "I am *the* pharmacist?" Listen. Undeceive yourself. Every housewife is a pharmacist, every loaf of bread is a pharmaceutical preparation. Do not the pulverized seeds of plants enter into the preparation of bread? Touches not the housewife the science of chemistry as well as of botany? Is not yeast a plant, does not its culture produce chemical changes, liberating from bread-dough both carbonic acid gas and alcohol? Is not the use of sour milk, sodium bicarbonate and cream of tartar in the making of bread a beautiful chemical process? Audacious would be the man, who, because he uses scientific terms and authoritative books, and mixes his ingredients by means of a mortar in a shop or laboratory, claims thereby that he is the only pharmacist. Have we not the home pharmacist? Is not

the kitchen a laboratory of scientific opportunity? Who knows the reactions that ensue in the roasting of beef or the browning of gravy?

Fruits grow and then ripen by means (intrusions) of lower organisms, often linked to animal life, or by inter-reactions akin to decay that breed ethereal flavors. Fruits and seeds are used in home pharmacy, and likewise sugar in the making of preserves, jellies, in canning, etc. In fact, old-time pharmacy, with its cordials, elixirs, sweetened mixtures, paste confections such as confections of roses, fig and senna, pillular or in mass, wedges very closely into home culinary manipulations.

And even closer relationships are bred by systematic observers of foods. Do not our mothers tell us that ripe currants should be sweetened after cooking, because the sugar disappears if they be cooked together; that pie crust should be made and rolled cold with as little manipulation as possible, the lard not being evenly incorporated if the crust is flaky? Good pharmacy is this. They advise that quinces be not *peeled,* in culinary (home) pharmacy, because quince flavor lies in the rind. Is not this true of other fruits, such as the orange, lemon, the apple? Do they not cook damson plums whole in order to get the flavor of the seed, the same rule applying to peaches and cherries? In fact, does not the kitchen very closely parallel the laboratory?

But, one may say, such as this is not pharmacy; these are not pharmaceutical preparations, but foods, nourishers, supportives of life. To this I would reply, where is higher pharmacy than the making of life supportives or of stimulating products to encourage digestion? The pharmacy of death is not my ideal. Consider, what about "beef, wine and iron," so widely advertised as an "exquisite" in pharmacy? What about "beef juice?" What about pepsin? Did not our mothers advise the lining to the gizzard as a digestive food? What about rennet used in our homes in making curd from time immemorial; what substitute have we given in its stead? Has pharmacy improved on the cheeses of the Orient made by means of vegetable curd products, so artfully established that temperature of milk in one night makes sour or sweet curd, as desired? If the milk be warm, next morning the curd or clabber is sour, if cold, it is sweet. [This and some things else I learned in Turkey, the land of cheeses and curds.]

What about the numberless drinks established on the outside that we in "pharmacy" have appropriated? Might we not better, in the face of fact, claim that our laboratory is an ally with our kitchen in the great field in which home pharmacy came first, and in which home pharmacy must be forever a vital problem?

But our text is now plant pharmacy, not the pharmacist, nor yet the motto, "Credit to whom credit is due." Bunch it all together, then ask, Where do plant life and plant pharmacy begin? Where can they end? Is the problem of plant pharmacy (vegetable service) restricted to man? Have we fairly credited vegetation's service in life functions? Have we not seen "through a glass darkly" when we perceive only starches, sugars, fats and nitrogenous flesh as life-giving supportives?

Do you know of any animal that does not depend for its very existence on *vitality* conserved by plant life? Is not the food of all animals derived from plants? Do we not depend on plant life as a mixture, not starch and sugar alone, for our existence? Are we not, therefore, in the life essence taken as a whole, a part of the vegetable kingdom, a transformed, perhaps transplanted part? Should we then, as one of nature's animals, define ourselves as moving plants, because our very life essence is transferred to ourselves from vegetation?

Seek as a second thought to resist the argument that all animals depend on vegetation for life and existence. Think, although the carnivorous animal, like the tiger, lives on flesh, is not his food derived from plant-eating creatures? Is not his vitality as well as substance but one step removed from energy gathered by another creature, his victim, who lives on the grass of the field or the leaves of the forest?

Bones come next in thought because they are generally considered *"inorganic."* But do we not go to plants for materials to form our bones? Can we nourish bone by a diet of stone that contains all the inorganic elements of bone? Do we not chiefly seek wheat and such as wheat to obtain our bone-producing elements, our calcium phosphates, and potassium compounds, all our so-called inorganics? Remember the fate of "Jackson's Bone Food," the compound syrup of the phosphates, introduced by the famous Professor Jackson, of the University of Pennsylvania, to theoretically supply needed earth to deficient bone structure. Theoretically it

was a "bone food," practically it was found to be inadequate. Too much laboratory outside the digestive mystery; nature rebelled. Let us, then, as pharmacists, think of plants as primitive gatherers of materials and vital energies anticipant to animal nourishment. Primitive we say, too often, when we face the inexplainable.

Good business as well as fair ethics is that of give as well as take. The animal lives its life and passes out. The plant comes again into its own; decay means but a transition step, the grass of the field grows over the resting place of the maiden and thrives above that of the philosopher. The cycle begins over again, old ocean and the sun's ray are its ever undying vitalizers.

Comes now another thought: Whether we live on land or sea, are we not all creatures of the ocean? Audacious conception! Let us think. Does not every form of life come from the ocean,* even to the tree growing on the mountain top, so remote from Mother Ocean that one might say, "There is no kinship here?" Does not that tree derive both its food and its vitality from the ocean? Old Ocean rises, falls, throbs, comes and goes endlessly, giving life to all that comes into or passes out of its bosom. Cut off the vapor of the ocean and no rain falls. Suppress that breath, dead is the world.

This breeds another thought, seemingly afar from pharmacy: What vitalizes the ocean, the earth's great reservoir of energy? Whence its power? Look to the sun. Exclaim, in the words of Osseon, "Oh, thou glorious sun!" Its rays uplift the vapor that nourishes all vegetation, its call raises the tides, the moon being secondary influence to that mighty phenomenon, paralyze these currents and the movements of the ocean and the life-giving winds bred therein move no longer over the land. Suppress its vapor and the rain ceases to fall, from shore to shore. The rivers dry, the fertile lands become barren wastes, vegetation withers and perishes, animals die, life disappears. The desert claims her own. Is not the life blood of animals but a touch of Old Ocean's dampness? Is not the life of man, even to the most interior portion of the continents, dependent on the distant ocean's wave?

*See old lecture. "The Ocean of Vitality, The Reservoir of Life." This Journal, January, 1922.

Listen. When Lord Roscoe turned his great telescope on the heavens it is reported that he estimated that 250,000 suns in one hour passed across his field of vision. Today astronomers consider such figures as these but factors in Heaven's Kaleidoscope.

Is not our sun one of the smaller sun-like orbs, our earth one of the smaller space-studding planets? What means this term space? Pass that thought, the conception is too great.

An astronomer hopes to calculate the distance of a star; he turns his instrument on that star and takes its location. On the earth is his telescope ever revolving around the sun. In six months the plant is on the opposite side of the sun. The astronomer is now distant from his former place of observation twice 92,000,000 miles, double the distance of the earth from the sun. Again he turns his telescope upon a very distant star. From the angle of that immense base line he hopes to calculate the distance of the earth from that far-off orb. But the problem is too great. There is no angle. Parallel are the lines. That astronomer needs make his calculations of space depths' treasures from other data. Is this plant pharmacy? Possibly not, but may I not ask who knows the influence of space and its mighty content on earth materials and life? Who knows the influences of unseen, unknown vegetations content on animal life?

Comes now the question: "From what source does the sun derive its power?" Needs we must now stop this line of reasoning. Agnostic enough am I to say, "I cannot comprehend, I know not; I am too feeble, too incapable to attempt to reason beyond life intricacies that nature spins from out the sun's rays." Turn again to Osseon, "Whence comes thy rays, O Sun! thy everlasting light?" Answer who may. May this speaker not add. Where ends the touch of the sun's ray that brings to us consciousness of the little we can grasp in Infinity's book?

Now you ask: "Is such as this plant pharmacy?" Let me answer by asking in turn: "Is not the very essence of plant pharmacy dependent on life's reservoir, maintained from out the energies of space, if plant pharmacy is a study of plant life?" Have not we the right, is it not our duty to consider this mighty subject as a whole as well as in detail? We who live and have our being by the grace of vegetation's service?

THE REFINING OF PALM OIL FOR EDIBLE PURPOSES.

By M. F. LAURO and W. H. DICKHART.*

Palm oil comes from the fruit of certain palm-trees. The chief and practically sole source of supply is the West Coast of Africa, between Gambia and Loanda. The oil is obtained from the outside fleshy portion of the fruit, and is not to be confused with palm-kernel or "P. K." oil from the seed or nut of the same fruit, which is white and resembles cocoanut oil very closely both physically and chemically. There is all the difference in the world between the two oils. Palm oil varies in color from light orange-yellow to a brick —or a dirty dark red, and in consistency from that of soft butter to tallow. The better grades are known as "soft" or low acid oils, such as those from Lagos and Dahomey. The "hard" or high acid content oils are inferior, such as those from the Niger and the Congo districts.

The chief uses are for soap and candle making. It is also employed in the tinplate industry to preserve the iron sheets from oxidation before dipping into the tin bath. This is because the oil is a non-drying and very stable one. It has been used to a slight extent in coloring oils and fats, as in oleomargarine and butter substitutes. In Africa, the natives use for food purposes the oil from the fresh fruit without any further refining than just boiling and skimming.

Because of the crude and primitive methods employed by the natives in its preparation, most of the palm oil that comes to this country is in an impossible condition for other than commercial purposes. As shipped, it may contain from ten to fifteen per cent. free fatty acids, but by the time it arrives here the content of acids has increased to from twenty to over fifty per cent. Considerable water and impurities as sticks, dirt and stones, sometimes intentionally added, are present.

It so happened that we came across a sample of "Bonny Old Calabar" oil, that was unusually clean, of good appearance and of low acid content. We took advantage of the opportunity thus presented, to treat the sample so as to fit the oil for edible use, by first refining with lye as is done here with cottonseed and other

*New York Produce Exchange.

edible oils, then bleaching and deodorizing. The data obtained would be of interest to those who have hitherto thought of palm oil only in a technical way.

It may seem strange that an oil used in soapmaking should be considered for food purposes, but when it is considered that palm oil is a natural fruit-product, and that other oils formerly used only technically have since been converted to food use by refining and eliminating objectionable impurities, there remains no real reason why this rather common oil should not by proper treatment make a good edible oil. So far as we know, there is no physiological objection to its use as such. The question of the palate alone remains.

The fact that operates most strongly against palm oil refining is the poor quality of the oil, due naturally to the lack of care in its preparation on the coast. Were the fruit properly handled, immediately collected and treated to obtain the oil without appreciable fermentation or hydrolysis setting in, circumstances and conditions that appear at present unattainable on account of the climate and native indifference to work, the oil produced would be low in acid and therefore capable of commercial refining. We have found that when the acid content is above fifteen per cent. the loss of oil and the mechanical difficulties involved are too great to permit refining on a wholesale scale. An 18 per cent. acid oil gave us a refining loss of about 50 per cent. On the other hand a 12 per cent. acid oil had a refining loss of less than a quarter of the total oil treated.

Analysis of the crude oil and the refined product:

	Crude	*Refined*
Moisture	2.04%	
Impurities (Dirt, etc.)	1.27%	
Unsaponifiable Fatty Matter	0.64%	
Free Fatty Acids (as oleic)	11.73%	0.10%
Specific Gravity at 99/15.5° C.	0.8556	0.8592
Iodine No. (Wijs)	54.3	53.5
Saponification No.	198.5	196.3
Index of Refraction @ 30° C.	1.4628	1.4627
Titre of the Fatty Acids	45.1	
Iodine No. of the Fatty Acids	52.1	
Neutralization No. of Fatty Acids	200.1	

The crude oil was refined with 13½ per cent. of 18 degree Baumé caustic soda with a loss of 23½ per cent. of the oil. The color and appearance of the refined oil were like the grade known as Red Sherbro. Its taste was sweetish and not unpleasant, but with a distinct palm oil aftertaste. The characteristic odor, that of violets, still persisted.

The soapstock from the refining process was thoroughly mixed and analyzed. Its color was a dirty orange-yellow, and its consistency hard and compact. No free alkali was present. The soap made by purifying the stock was of excellent appearance and grain, quite hard, lathered well and possessed good detergent properties.

Water	27.58%
Total Fatty Matter as Fatty Acids	62.23%
Free Oil	24.95%
Total Alkali as Na_2O	3.10%
Glycerine	2.20%
Impurities	5.30%
Titre of the Fatty Acids	44.8
Iodine No. of the Fatty Acids	52.5
Neutralization No. of the Fatty Acids	199.7

The coloring matter of palm oil is not affected by the lye refining. It may be bleached out by bichromate of potash and muriatic acid, by means of hot air, or by long exposure to light. Heat alone will take the color out. We preferred the last method so as not to introduce foreign substances in the oil. We at first experimented to see how and when the heat caused the color change. At 210° C. the color started to leave and at 255° the color change was definite.

It was, however, not complete, being from a deep orange-red at first, to a light butter-yellow. On the Lovibond scale this read 35 Yellow—6.3 Red, which is within the limit of a Prime Summer Yellow cottonseed oil in so far as color is concerned.

The temperature of the moisture oven was finally adopted for the bleaching process, 105 to 110 degrees Centigrade. The oil, we placed in shallow glass and aluminum dishes for several days at this heat. It was found that aluminum worked more quickly and better, perhaps because the metal acts as a catalyst in this case. The

Lovibond color on the resulting bleached oil was 14 Yellow—1.4 Red, while liquid, a ratio like peanut oil of ten yellow to one red. In fact, it resembles while in a liquid state the color of a white peanut oil, a light green-yellow. As a fat, which it is at ordinary temperature, the color is practically white like cocoanut or palm-kernel oil, except for a slight yellow tint.

Incidentally some of the bleached sample was used to make up a zinc ointment, which compared very favorably with the U. S. P. ointment made with benzoinated lard. The palm oil was slightly harder, and is more stable than lard; hence such an ointment would keep better and not flow as easily as the lard ointment during the summer months.

We now subjected the bleached oil to the deodorizing process, which is chiefly one of injecting live steam into the oil while heated, and thus eliminating the volatile acids that give palm oil its distinctive odor and taste. As we were rather limited in our equipment, we were not able to completely deodorize the sample. However, the flavor of the oil was sweet, with a very slight aftertaste, which was not unpleasant, resembling somewhat the taste of cornmeal.

Analysis of the refined, bleached and deodorized oil:

Specific Gravity @ 99/15.5° C.	0.8596
Iodine No.	53.2
Saponification No.	196.0
Index of Refraction @ 30° C.	1.4634
Melting Point (Capillary method)	40.8° C.
Halphen Test for cottonseed oil	Negative
Villavecchia Test for sesame oil	Negative

The Halphen test at the end of two hours showed a deepening of the yellow color, but the characteristic pink or red of cottonseed oil was not present. In the Villavecchia test, the color produced was a light, pink brown like some Spanish olive oils, and which like them disappears on dilution with water.

The contrast in the deep orange-red of the refined or the crude, and the white of the bleached oils, and the practical elimination of odor and taste, indicate in vivid and concrete manner the possibilities of an extensive use of this rather common oil for edible pur-

poses, taking its place among the fats or the hardened oils used in the manufacture of nut butters, margarine and lard compounds. There are not so many natural vegetable fats available for these purposes. The oils are too soft, and must be either treated by freezing to remove the stearine or converted by hydrogenation to a hardened product. In this climate, palm oil is a fat and a fairly hard fat. Hence, when the conditions of its cultivation and preparation are improved, palm oil should find a ready market as an edible oil.

FOUNDERS' DAY CELEBRATION AT THE PHILADELPHIA COLLEGE OF PHARMACY AND SCIENCE.

INTRODUCTORY REMARKS DELIVERED BY PRESIDENT W. C. BRAISTED.

To the Members of the College, Our Guests, Ladies and Gentlemen:

We meet again today, the second time in the history of this College, to celebrate "Founders' Day" and to remember and honor the founders of this institution and the group of men who more than one hundred years ago, took the steps that have resulted in the establishment of this great College, with its thousands of graduates, its years of splendid achievement and a wealth of good to humanity, that has made its name known throughout the world and the institution itself the pioneer and for years the leader in all that pertains to pharmacy and its allied sciences.

A year ago the College completed its hundredth year of toil and accomplishment and the first celebration of Founders' Day was inaugurated.

A most interesting history of the origin and growth of this institution was given us by Dean La Wall, together with the history and names of the founders and the little group of men who began the College body. His address is still fresh in your minds, I am sure, and accessible for all time in the records of this institution. It is, therefore, unnecessary for me to review the work that Dean La Wall has so ably and carefully done.

I think, however, that we should always bring to our minds the names of these men—they are:

Samuel Jackson, M. D.
Daniel B. Smith
Robert Milnor
Peter Williamson
Stephen North
Henry Troth
Samuel Biddle
Charles Allen and
Frederick Brown.

It is to be noted that they were mostly young men under thirty and that their lives were actively connected with the business activity of this city. Most all were men who reached more or less prominence in their chosen vocations and were remarkable for courage, industry, integrity and attainment.

With these names we should remember and give reverent thought to the group of the sixty-eight Charter Members of the College body.

If they could have seen the far-reaching benefits and results of their work in the one hundred years of the existence of this Collge, they would have felt well rewarded for the hard work and early struggle for existence.

The splendid results of their efforts stand out before us (the present representatives of this institution) and looking ahead to the next hundred years, should cause us to pause and create a second vision of what *we* can do in the years to come to enhance the value of the rich legacy they have left us. Can we carry on undimmed and unblemished the work entrusted to us? Can we, starting now with the results of the hundred years of their work, produce another century's work that will find us as far ahead of today as their work has advanced during the century passed?

Dear friends, we are at a very critical period of our work. We are looking ahead for the days to come, with high hopes and great ambitions for expansion of our college, for rich returns for our efforts for the good of humanity through this work and looking and hoping for the reward that comes only from successful attainment in adding to the useful store of knowledge that will benefit our fellow-men.

Soon splendid plans for the future will take shape, in fact are taking shape now, that if successfully carried out, will make

our work of the century to come, one of the great outstanding advances in the world's work. Have we the vision to see, the cool heads to successfully plan, and the endurance and ability to bring to successful completion the glorious opportunity before us? With united effort and harmonious and friendly co-operation I believe we can succeed and the coming generations will yield to us the generous mead of acknowledgment of work well done, that we today so gladly give to those who so long ago had the courage and strength to inaugurate the splendid accomplishment we are commemorating this day.

PROFESSIONAL ETHICS.*

By Dr. Judson Daland,

Professor of Medicine, Graduate School of Medicine, University of Pennsylvania.

Mr. President, Ladies and Gentlemen—

It is, indeed, a great pleasure to meet with you this evening, and, in accepting the invitation of your Dean, Dr. LaWall, I fully expressed my appreciation of the honor of joining with you in celebrating the one hundred and first anniversary of Founders' Day.

I also welcomed the invitation because it gave me an opportunity of expressing publicly, what I believe to be the opinion of the medical profession of the United States, that *your* College is to be heartily congratulated upon having secured as its President, Dr. William C. Braisted, whose brilliant achievements during the war, in the discharge of the onerous and difficult duties as Surgeon General of the United States Navy, cannot fail to excite our admiration and enthusiasm. It was my good fortune, as an officer in the United States Navy, to serve under him, and from personal knowledge, I know that he possesses character, judgment, experience and vision, combined with *executive ability* of the highest order, *all* of which will be devoted to *accelerating* the progress of the Philadelphia College of Pharmacy and Science, and under his masterly leadership, *success is assured.*

*Delivered on Founders' Day, at the Philadelphia College of Pharmacy and Science, February 23, 1922.

Pharmacy is a profession and a business, and today is *more* of a profession than *ever* before, and in the future this aspect of pharmacy is sure to steadily increase and, therefore, professional ethics is of *increasing* importance.

Ethics is fundamentally synonymous with right doing, and the various codes that have been established by the pharmaceutical profession are attempts to formulate rules for guidance.

The medical profession formulated the *first* code of ethics, known as the Hippocratic Oath, about 2500 years ago.

Pharmaceutical ethics may be considered from the following standpoints:

1. The pharmacist himself;
2. His relationship to his profession;
3. To the medical profession;
4. To the public;
5. And to the government.

I shall, however, confine myself to the pharmacist as a man and his relationship to the medical profession.

Pharmacists of intelligence, possessing lofty principles and good character, usually act ethically under almost any condition that may rise, and only exceptionally find it necessary to refer to a code of ethics. Fundamentally, therefore, the knowledge imparted to the student by your faculty, coupled with character, promotes ethical conduct.

In medicine, and it is perhaps also true in pharmacy, *no* systematic instruction is given in character building, nor is its importance emphasized, and *no* precise study is made of the character of students presenting themselves for graduation.

For many years I have held the opinion that, even though a student of medicine passes all examinations successfully, he should *not* receive a degree if he did *not* possess *good* character, and I believe this principle is also true for students of pharmacy.

In the last analysis, both in medicine and pharmacy, the proper discharge of the duties of these professions rests upon individual consciousness of right or wrong, and, as most of the work is confidential and performed in private the chief factor in doing right is a properly developed moral consciousness.

In order tc develop, increase and maintain a proper ethical spirit, it is necessary that, in addition to receiving a thorough education in pharmacy the student should be instructed as to the importance of a keen sense of right and wrong, truth, justice, right living, right thinking, right doing, moral consciousness and lofty ideals, in a word, *good character.*

Unethical conduct is usually due to ignorance, poverty or avarice. Instructions given by the Faculty of the Philadelphia College of Pharmacy and Science, removes professional ignorance. A student must be taught that, in the beginning years of his work, which is partly of the nature of post graduate instructions, that he must be content with a moderate remuneration, and should not feel the necessity of being unethical in order to secure a greater financial return.

Avarice may be congenital or acquired, is difficult of detection and correction, and *may* be overcome by knowledge and the development of character.

If a pharmacist has acquired character and discretion, he will know what to do when questions arise concerning badly written prescriptions; the necessity of accuracy in compounding prescriptions; that drugs dispensed must fully represent their physiologic activities; the evils of secret formulæ; the impossibility of substituting another drug for the one ordered, or the giving of commissions to physicians.

The splendid work of the *Journal of the American Medical Association* and other institutions and individuals, and the law compelling manufacturers of secret remedies to make known their composition, has *repeatedly* demonstrated the *uselessness* or *harmfulness* of quack remedies that are *only made to be sold at a profit.*

No pharmacist should debase his profession by selling such nostrums.

I realize the financial loss thus incurred, but right conduct frequently necessitates temporary loss, which is compensated for by the personal satisfaction of doing right and by the increase in the confidence of the public as well as that of the medical profession.

Enormous sums of money are lost annually by owners of publications who decline to print advertisements of manufacturers of quack remedies or nostrums, as, for example, daily newspapers like the *Public Ledger* of Philadelphia, or weekly publications like the *Saturday Evening Post,* or the *Journal of the American Medical Association.*

If the owners of such publications are willing to incur so great a financial loss *for purely ethical reasons,* the pharmacist should *likewise* be willing to sacrifice profits arising from the sale of Quack Remedies.

The Philadelphia College of Pharmacy and Science, for more than a century, has always insisted upon the highest ethical ideals, and the members of the present Faculty, following in the footsteps of their distinguished predecessors, desire to still further elevate the profession of pharmacy. I bespeak for them the hearty and enthusiastic support, not only of the alumni and friends of this institution, but all members of the medical and pharmaceutical professions of Philadelphia, Pennsylvania and the United States.

ABSTRACTED AND REPRINTED ARTICLES

PHARMACEUTICAL ETHICS.*†

A Historical Review of the Subject With Examples of Codes Adopted or Suggested at Different Periods, Together With a Suggested Code for Adoption by Present-Day Associations.

By Charles H. Lawall.[1]

Among the earliest of the State associations to formulate and adopt a code of ethics was the Pennsylvania Pharmaceutical Association, which in 1881 adopted the following:

"PENNSYLVANIA PHARMACEUTICAL ASSOCIATION CODE OF ETHICS.

"Preamble. The members of the Pennsylvania Pharmaceutical Association, considering it necessary that some mutual understanding should exist in regard to the moral principles guiding them in their profession, hereby agree upon the following code of ethics:

*Presented before Section on Education and Legislation, A. Ph. A., New Orleans meeting, 1921.

†Reprinted from the *Journal of the American Pharmaceutical Association*, Vol. X, Nos. 11 and 12. November and December, 1921.

[1] Dean of the Philadelphia College of Pharmacy and Science.

"1. We accept the United States Pharmacopoeia as our standard and guide for all official preparations, and recognize a variance from its rules only in exceptional cases, where sufficient authority has proven some other process more reliable to attain the same end.

"This section is not intended to interfere with the dispensing of prescriptions or medicines ordered in accordance with foreign Pharmacopoeias.

"2. Although not a legitimate part of our business, custom and the necessity of the times warrant us in keeping the proprietary medicines of the day; yet, out of regard to the medical profession, and for the protection of the public, we earnestly recommend all pharmacists, when called upon for an opinion of their merits, to discourage their use, and neither to advertise nor permit their names to be used in advertising such medicines.

"3. Recognizing the value of alcohol as a therapeutic agent, and the propriety of its being dispensed as such by pharmacists, yet deploring the wide-spread evil resulting from its indiscriminate use in its hundreds insidious forms, we condemn any attempt to make it a prominent feature of our business as unprofessional; and we denounce the loose practice of allowing it to be used on the premises, in any shape, as a beverage, as degrading, and we urge upon pharmacists the duty of exercising, at all times, a conscientious care in dispensing a drug liable to such dangerous abuse.

"4. We discountenance all secret formulas between physicians and pharmacists, and consider it our duty to communicate such to each other when requested.

"5. We distinctly repudiate the practice of allowing physicians a percentage on their prescriptions as derogatory to both professions.

"6. We will endeavor, as far as it lies in our power, to refrain from compromising the professional reputation of physicians, and we expect the same comity from them.

"7. Since the professional training of the pharmacist does not include those branches which enable the physician to diagnose and treat disease, we should, in all practicable cases, decline to give medical advice, and refer the applicant to a regular physician.

"8. The growing demands of the age require that those who follow the profession of pharmacy should be educated to a higher standard. Therefore, we consider it our duty, individually and collectively, to encourage the advancement of knowledge in our

profession generally, and particularly by stimulating our assistants to attend the lectures of a college of pharmacy, and by aiding and assisting them to do so.

"9. Considering it expedient that some rule should be adopted to enforce the provisions of our code, we hereby agree, if any just cause of complaint of its violation be found against a member of this Association, to bring the case before a special, or the next general meeting of the Association, when the accused, after being heard in his own defense, may be expelled by a vote of two-thirds of all the members present."

This code is more nearly applicable to present-day conditions than any which have been thus far quoted. Section 3 is particularly interesting as showing the attitude of our professional brethren of nearly half a century ago upon the alcohol question.

In 1877 a committee of three physicians and three pharmacists of the City of Antwerp drew up interprofessional rules, which give us a starting point for medico-pharmaceutical ethics:

"RULES OF THE ANTWERP MEDICAL AND PHARMACEUTICAL PROFESSIONS.

"1. Each member of the two branches of the medical corps should abstain from interfering with the prerogatives of the other; the physician should not furnish any medicine to his patients, and the pharmacist should avoid giving medical advice; the pharmacist may, within the limits of the law, furnish medicines which may be asked for, such as a cough mixture, a sedative draught, a purgative, copaiba capsules, etc., without, however, advising that such or another preparation was more suitable.

"2. The physician and pharmacist should conduct themselves toward each other with the sentiments of kindness and confraternity, which unite the members of a family, and should avoid, in the presence of the client, every kind of reflection and unfair remarks; a conciliatory council should be appointed for smoothing such disputes as may arise on the subject of medical practice.

"3. Finally, physicians should, as rarely as possible, prescribe secret remedies and pharmaceutical specialties; on the other hand, pharmacists should abstain from advertising them."

Our own fellow member, the late Henry P. Hynson, formulated a code of ethics for the Maryland Pharmaceutical Association

which was a distinct advance over the former codes in that it takes into account the complex relationships and interdependencies of modern pharmacy.

"HYNSON'S CODE OF ETHICS.

"For the guidance of members of this Association and all pharmacists of the State who may wish to follow the higher practice of their profession:

"Respecting the Pharmacist Himself.

"1. He should, by study, experimentation, investigation and practice, thoroughly qualify himself to fully meet and competently transact the daily requirements of his vocation.

"2. He should possess a good moral character, and should not be addicted to the improper use of narcotic drugs nor the excessive use of alcoholic stimulants.

"3. He should constantly endeavor to enlarge his store of knowledge; he should, as far as possible, read current pharmaceutical literature; he should encourage all such pharmaceutical organizations as seem to be helpful to the profession, and so deport himself as not to detract from the dignity and honor of the calling which this Association, especially, is trying to elevate.

"4. He should accept the standards and requirements of the U. S. Pharmacopœia and the National Formulary for the articles of Materia Medica and the preparations recognized by these publications and, as far as possible, should promote the use of these and discourage the use of proprietaries and nostrums.

"Respecting the Pharmacist's Relations with Those from Whom He Makes Purchases.

"1. He should deal fairly with these; all goods received in error or excess and all undercharges, should be as promptly reported as are shortages and overchanges. Containers not charged for or not included in the charge for contents should be carefully returned, or, if used, should be credited to the party to whom they belong.

"2. He should earnestly strive to follow all trade regulations and rules, promptly meet obligations, closely follow all contracts and agreements and should not encourage or sanction any division of quantity purchases not contemplated in the terms of sale.

"Respecting the Pharmacist's Relations with His Fellow Pharmacist.

"1. In this relationship he should, especially, 'do as he would be done by.' He should not make any comment or use of any form of advertisement that will reflect upon the members of the profession, generally or specifically. Nor should he do that which will in any way discredit the standing of other pharmacists in the minds of either physicians or laymen.

"2. He should not obtain, surreptitiously, or use the private formulas of another, nor should he imitate or use another's preparation, labels or special form of advertising.'

"3. He should not fill orders or prescriptions which come to him by mistake. Prescription containers with copies and labels of another pharmacist upon them may be filled by him upon request, but he must invariably replace the labels with his own, thereby assuming proper responsibility.

"4. He should never request the copy of a prescription from another pharmacist; the owner of the prescription alone being entitled to a copy, is the proper person to ask for it.

"5. He may borrow merchandise from another pharmacist, provided the practice is reciprocal and equally agreeable to both parties; but the better form is to pay a sum for the desired article equal to the cost and half the profit to be obtained.

"Respecting the Pharmacist's Relations with Physicians.

"1. He should positively refuse to prescribe for customers except in cases of urgent emergency.

"2. He should not, under any circumstances, substitute one article for another, or one make of an article for another, in a physician's prescription, without the physician's consent.

"3. He should refuse to refill prescriptions or give copies of them when so instructed by the physician.

"4. He should not place copies of prescriptions upon containers unless ordered to do so by the prescriber, even though the patient should request it. Nor should he use any word or label like 'For external use,' 'Poison,' 'Caution,' etc., without due regard for the wishes of the prescriber, provided the safety of the patient and family is not jeopardized.

"5. Whenever there is a doubt as to the correctness of the physician's prescription or directions, he should invariably confer

with the physician in order to avoid possible mistakes or unpleasantness; changes in prescriptions should not be made without such conference.

"6. He should never discuss physicians' prescriptions with customers, nor disclose to them their composition.

"Respecting the Pharmacist's Relations with his Patrons.

"1. He should seek to enlist and merit the confidence of his customers, which, when won, should be jealously guarded and never abused by extortion or misrepresentation.

"2. He should supply products of standard quality only to patrons, excepting when something inferior is specified and paid for by them.

"3. He should charge no more than fair, equitable prices for merchandise, and prescriptions; the time required for the proper preparation of prescriptions should be duly considered and paid for.

"4. He should hold the safety and health of his patrons to be of first consideration; he should make no attempt to treat diseases nor strive to sell nostrums or specifics simply for the sake of profit.

"5. He should consider the reckless or continued sale of drugs to habitues, the illicit sale of abortive medicines or poisons, to be practices unbecoming a gentleman, a pharmacist or a member of this Association."

In this code we see the constructive thought of a high minded pharmacist, who evolved something which is essentially different in both form and scope from those which have been previously quoted. His model seems to have been The Principle of Medical Ethics of the American Medical Association, the present form of which was adopted in 1912, and which, like the foregoing is divided into chapters and sections.

At this time it might be appropriate to quote from the Code of Ethics of the American Medical Association in so far as it pertains to pharmacy.

"Chapter III. Section 4.

"Pharmacists.

"By legitimate patronage physicians should recognize and promote the profession of pharmacy; but any pharmacist, unless he

be qualified as a physician, who assumes to prescribe for the sick, should be denied such countenance and support.

"Moreover, whenever a druggist or pharmacist dispenses deteriorated or adulterated drugs, or substitutes one remedy for another designated in a prescription, he thereby forfeits all claim to the favorable consideration of the public and physicians."

This is sound and correct as far as it goes, but it leaves something to be desired as to completeness.

Mr. P. A. Mandabach, the late head of the National Association of Drug Clerks, suggested a code of ethics four or five years ago, which is well worth repeating here:

"Mandabach's Code.

"The — — —, recognizing that mutual understanding must exist regarding the ethical and moral principles guiding its members in their personal, professional, and commercial activities, hereby adopts the following code of ethics:

"Section 1. Members of this Association shall regard themselves as being engaged in a business in which there is a well-defined legal and moral duty and obligation toward public health and life, and shall apply all honorable means in upholding the dignity and honor of the business and profession.

"Section 2. The United States Pharmacopœia shall be accepted as the standard and guide for all official preparations, and a variance from its rules be recognized only in exceptional cases where sufficient authority has proved some other process more reliable in attaining the same end. Nothing herein, however, shall interfere with the filling of prescriptions or the selling of medicines ordered in accordance with foreign pharmacopœias, officially recognized textbooks, and formularies.

"Section 3. The value of alcohol as a therapeutic agent, and the legal dispensing thereof as such an agent only, is recognized. The sale of alcohol as a beverage and of unlawful abortives or habit-forming drugs shall be considered sufficient grounds for expulsion of the offender from membership in the association. The secretary of the association shall then so report this action to the secretary of the State Board of Pharmacy recommending the revocation of the certificate of registration, as provided for by the State Pharmacy Law.

"*Section 4.* Members shall not be a party to the practice of the commission system or secret formulæ between physicians and pharmacists.

"*Section 5.* Members of this association shall not falsely or maliciously, directly or indirectly, injure the personal or business reputation of a fellow member. Members shall at all times uphold the professional reputation of physicians, in return expecting the same consideration from the medical profession.

"*Section 6.* In view of the fact that the professional training of the pharmacist does not qualify him intelligently to diagnose and treat diseases, members shall decline to give medical advice, and refer the general public seeking such advice to a regular practicing physician.

"*Section 7.* Recognizing the dignity of the profession and believing that those who wish to follow commercial and professional pharmacy successfully must be educated to a higher degree, the association declares itself in favor of prerequisite laws tending to higher standards of pharmaceutical education, and calls upon all members to assist apprentices and assistants in securing adequate collegiate pharmaceutical education.

"*Section 8.* Members shall be governed in the sale and merchandising to the general public of all patent and proprietary remedies and medicines by all State and national laws relating thereto.

"*Section 9.* Members shall expose without fear or favor, all corrupt work, methods, and practices found to exist in the business. They shall bring to the attention of the proper authorities all known violations of State and federal laws as applied to pharmacy, public life and health.

"*Section 10.* In order that the provisions of this code be enforced, each member shall report to the executive board of this association all infractions of this code by any member. If the charges be sustained, after a fair and impartial trial, the accused being heard in his defense, the secretary shall by order of the executive board, expel such person from membership."

The National Association of Retail Druggists have no Code of Ethics as such, but the Preamble and objects as stated in their constitution are practically equivalent as will be seen from the following:

"WHEREAS, the best interests of the people require a high degree of scientific training and professional standing on the part of retail druggists, and

"WHEREAS, it is the duty of our profession to champion all measures which conserve the health of the individual and the community, and

"WHEREAS, the professional and commercial interests of druggists require for their protection united action, we do form a national organization of retail druggists. To effect the purpose of the organization the following Constitution and By-Laws are adopted:

"Article I—Name.

"The name of this organization shall be 'The National Association of Retail Druggists.'

"Article II—Objects.

"The objects of the Association shall be:

"1. To insist upon such training for our professional work as is commensurate with the demands made upon us and is called for by the close relation of our profession to the health and welfare of the community.

"2. To devise ways and means for maintaining a high standard of professional work.

"3. To promote by every means in our power all measures and all legislation honestly intended to prevent the adulteration of foodstuffs and substances used in the preparation of medicines."

The remainder concerns the commercial phases of the organization.

The most recent contribution to the subject which I have seen and the last which I shall quote, comes to us from far across the seven seas. It is take from the *Journal of the American Medical Association*, September 22, 1917, with the accompanying favorable introduction:

"Medicopharmaceutic Ethics.

"At a conference held in Melbourne between representatives of the Victoria Branch of the British Medical Association and representatives of the Pharmaceutical Society of Australasia, the Pharmacy Board and Pharmaceutical Defence Ltd., the following rules of practice, among others, were adopted. The rules are so common-sense that they are worthy of consideration in this country.

"1. *Prescriptions—Doubtful Interpretations.*—In cases where there is some doubt regarding the interpretation of any prescription, it shall be the duty of the pharmacist dispensing the same to communicate with the prescriber if possible. It is preferable that such communication should be in writing. In cases where it is necessary to telephone to the prescriber, care should be taken to see that the conversation is as private as possible.

"2. *Correction by Prescriber.*—The prescriber in such a case will recognize that the pharmacist is simply performing what is an important part of his professional duty, and will at once co-operate with him in the interest of his patient. He will correct or confirm the prescription. If a correction is necessary, he may request the pharmacist to retain the prescription, and will forward to him the corrected one. As far as possible, verbal corrections should be confirmed in writing.

"3. *The Attitude of Prescriber and Dispenser* should be one of mutual respect and co-operation.

"4. *Unusual Characteristics.*—In cases where a prescription contains (*a*) an incompatibility, (*b*) an unusually large dose, (*c*) a dangerous dose, or possess some other characteristic of an unusual nature, the prescriber shall indicate that such peculiarity is intended, and is not inadvertent, by underlining that particular part of the prescription, and initialing the same in the margin.

"5. *Where Prescriber Cannot be Consulted.*—Where a pharmacist is doubtful of the interpretation of a prescription, and it is not possible to consult the prescriber, he shall, after careful consideration, modify the prescription in accordance with what he believes to be the intention of the prescriber. He should, if possible, subsequently communicate with the prescriber by letter, and inform him of what he has done. Care should be taken to see that such discretion, when exercised, does not interfere with the therapeutic value of the medicine.

"6. *Modifications to Be Noted.*—Where a pharmacist finds it necessary to modify a prescription, under paragraph 5, he should make a marginal note on the prescription indicating the course he has adopted in dispensing the prescription. The marginal note should be as brief as possible.

"7. *Prescribing by Telephone.*—When prescriptions are dictated by telephone, the following rule should be observed: The prescriber should first write out the prescription, and then read it through the telephone to the dispenser. He should request the dispenser to read to him the prescription as taken down, and should, as soon as possible, forward the original prescription to the pharmacist either by post or by the patient.

"8. *Criticism Deprecated.*—It is undesirable that a prescriber should adversely criticize a pharmacist unless he is guilty of some offense in his calling. The pharmacist on his part should refrain from discussing with the patient the prescriber or the merits of his prescription. Matters relating to professional fees or prices charged for medicines should not be discussed with patients.

"9. *Unsigned Prescriptions.*—When a prescription is received with the 'usual signature,' the pharmacist should ascertain from the patient the name of the prescriber, and, if possible, submit the prescription for his signature before dispensing it so as to relieve the prescriber as well as himself from the risk of penalty. The use of a rubber stamp in lieu of the prescriber's written signature should be avoided.

"10. *Repetition of Prescriptions.*—When it is desired that a prescription should not be repeated, the prescriber should write on the prescription, 'Not to Be Repeated,' or 'To Be Repeated Twice Only,' or any specific number of times. In cases where such directions are given, the pharmacist who dispenses the prescription should indorse the prescription as follows: Supplied (here insert date and pharmacist's signature).

"11. *Spoonfulls—to Be Abandoned.*—With the object of securing greater accuracy in dosage, the use of the words *'teaspoon, dessertspoon,* and *tablespoon'* in the directions on a prescription should be discouraged. Prescribers should write the dosage in drams or ounces, and patients should be advised to measure the doses in a measure-glass."

An interesting contribution to the subject was made in 1910 when the Delegates from the Medical Society of New Jersey to the U. S. Pharmacopœia Convention, presented to that body for consideration the following:

"Ethical Rules for the Guidance of Physicians and Pharmacists in Their Relations with Each Other and with the Public.

"Propositions.—1. Ethical principles or standards of right conduct exist irrespective of their formulation or codification.

"2. Ethical rules are calculated to elevate standards of moral conduct and foster a spirit of harmony between professional men.

"3. A code of ethics is designed not only for the restraint of those who are actuated by unworthy motives, but for the guidance of those, also, who seek to be governed in their actions by high and true principles.

"The Duties of the Physician to the Pharmacist.—1. The physician has no moral right to discriminate in favor of one pharmacist to the detriment of another, except for dishonesty, incompetency or unscientific methods of work.

"2. The physician is never justified in receiving from a pharmacist gratuities in return for patronage; in depositing secret formulas with an individual pharmacist, or by word or deed to jeopardize his professional reputation.

"3. The physician may sometimes find it an advantage to the patient to dispense medicine. Yet, in the main it must be regarded as a subterfuge and a hindrance to all interests involved. The physician should, if practicable, avail himself of the superior technical skill of a trained pharmacist in the preparation and dispensing of medicines.

"4. The pharmacist who recommends drugs or medicines for specific remedial purposes either directly or through the avenues of advertisement thereby exceeds the limits of his profession and commits an act unworthy of his calling.

"5. The pharmacist who consents to diagnose disease or prescribe for patients except where emergencies arise, without a proper medical training, assumes responsibilities for which he is not qualified and justly incurs the disapproval of physicians.

"6. The pharmacist transgresses his true province when for commercial purposes he issues to physicians printed matter setting forth the therapeutic indications for the use of drugs or medicinal preparations. The constituents of a drug or compound together with its chemical and physical properties should be a sufficient guarantee of its utility.

"The Duties of the Physician and the Pharmacist to the Public.—7. The combined efforts of the physician and the pharmacist are required to protect the public from the nostrum maker, the pseudo-scientific pharmacist, the sectarian physician and drug vendor, and the two should be in continual alliance to demand the extermination of these commercial and mercenary institutions.

"8. The physician and the pharmacist should, as far as possible, limit the multiplication of manufactured proprietary compounds. It must be regarded as reprehensible to encourage the use of these remedies to the exclusion of those which are official in the pharmacopœias. It is also their plain duty to discourage the use and sale of all medicines which lead to baneful drug habits.

"9. The best interests of the patient are undoubtedly conserved by the custom of physicians to practice rational therapeutics to the exclusion of those methods which tend to the use of many remedies or those of unknown composition; and the supreme effort of the dispensing pharmacist should be to complete the circle of therapeutics by supplying the demands of experimental and chemical teaching with eligible and trustworthy preparations."

This brings some features of present day practice of both pharmacy and medicine into merited prominence.

In the illustrations that have been given, covering all periods and the practice of many countries, we certainly should have sufficient data for the drafting of a modern code of ethics applicable to present day pharmacy in its broadest and most complex sense Many other examples might be quoted from state pharmaceutical associations, etc., but in none of them is there anything essentially new and they are all founded upon one or more of the foregoing examples.

Simplification and conciseness is a desirable quality for which to strive, but beyond a certain point we lose more than we gain when we attempt to condense the material at hand. We must not forget the well known example of Dr. Oliver Wendell Holmes, to illustrate the complexity of a dialogue between John and Henry, in which he convinces his readers that there are six persons taking part in such a conversation, *viz.*, first, John as Henry knows him; second, John as he knows himself; third, John as his Maker knows him; fourth, Henry as John knows him; fifth, Henry as he knows himself; sixth, Henry as his Maker knows him.

The fundamental data can be simplified no further than:

1. The relation of the pharmacist to the public.
2. The relation of the pharmacist to the physician.
3. The relation of the pharmacist to his fellow pharmacist.

In analyzing the codes studied, from this viewpoint, we find that some are top heavy in one direction and entirely lacking in another. It is doubtful if any can be formulated which would not need revision at the end of a decade.

It should be the aim of every pharmaceutical organization to adopt and use as a working guide a code of ethics founded upon sound fundamental principles. This should be freely circulated and kept before the membership by having it printed on each application for membership or upon a separate sheet to be used in connection therewith and it should also be printed in each copy of the Proceedings along with the constitution and by-laws. There are many associations, I know, including our own, where the majority of the members not only have never seen the code of ethics, but would not be able to find it unless they happened to own a complete set of the Proceedings of the organization, and even then only after some difficulty.

A great part of the advance which medicine has made in the past century has been undoubtedly due to the development of a professional class consciousness through the medium of medical ethics, a subject which is instilled into every member of the profession from the time when he first becomes a student, and which he meets at every turn during his active years of practice.

We have much to gain, therefore, in prosecuting diligently the effort to make pharmaceutical ethics mean something vital to the every day welfare and the ultimate advantage of every member of the pharmaceutical profession. With this object in view I hereby suggest the following as a basis for discussion, in the hope that it will result in the prompt adoption of a code of pharmaceutical ethics that will meet the requirements of present day conditions, for our association and any others which care to take advantage of it and adapt it to their particular needs.

PRINCIPLES OF PHARMACEUTICAL ETHICS.

CHAPTER I.

The Duties of the Pharmacist in Connection with his Services to the Public.

Pharmacy has for its primary object the service which it can render to the public in safeguarding the handling, sale, compounding and dispensing of medicinal substances.

The Practice of Pharmacy demands knowledge, skill and integrity on the part of those engaged in it. Pharmacists are required to pass certain educational tests in order to qualify for registration under the laws of most of our states. These various states restrict the practice of Pharmacy to those qualifying according to the regulatory requirements thereby granting to them a special privilege which is denied other citizens.

In return the States expect the Pharmacist to recognize his responsibility to the community and to fulfill his professional obligations honorably and with due regard for the physical well being of society.

The Pharmacist should uphold the accepted standards of the United States Pharmacopœia and the National Formulary for articles which are official in either of these works and should, as far as possible, encourage the use of these official drugs and preparations and discourage the use of proprietaries and nostrums. He should use only pure drugs and chemicals of the best quality obtainable for prescription filling and for sale when the articles are to be used for medicinal purposes.

He should neither buy, sell nor use substandard drugs except for uses which are not in any way connected with medicinal purposes. When a substance is sold for technical use the quality furnished should be governed by the grade required for the stated purpose.

The Pharmacist should be properly remunerated by the public for his knowledge and skill when used in its behalf in compounding prescriptions, and his fee for such professional work should take into account the time consumed as well as the cost of the ingredients.

The Pharmacist should not sell or dispense powerful drugs and poisons indiscriminately to persons not properly qualified to admin-

ister or use them, and should use every proper precaution to safeguard the public from poisons and from all habit forming medicines.

The Pharmacist, being legally entrusted with the dispensing and sale of narcotic drugs and alcoholic liquors, should merit this responsibility by upholding and conforming to the laws and regulations governing the distribution of these substances.

The Pharmacist should seek to enlist and merit the confidence of his patrons and when this confidence is won it should be jealously guarded and never abused by extortion or misrepresentation or in any other manner.

The Pharmacist should consider the knowledge which he gains of their ailments, and the confidences of his patrons regarding these matters, as entrusted to his honor, and he should never divulge such facts unless compelled to do so by law.

The Pharmacist should hold the health and safety of his patrons to be of first consideration; he should make no attempt to prescribe or to treat diseases or strive to sell nostrums or specifics simply for the sake of profit. When an epidemic prevails, the Pharmacist should continue his labors for the alleviation of suffering without regard to risk of his own health and without consideration of emolument.

He should keep his store clean, neat and sanitary in all its departments and should be well supplied with accurate measuring and weighing devices and other suitable apparatus for the proper performance of his professional duties.

It is considered inimical to public welfare for the Pharmacist to have any clandestine arrangement with any physician in which fees are divided or in which secret prescriptions are concerned.

Pharmacists should primarily be good citizens, should uphold and defend the laws of the State and nation. They should inform themselves concerning the laws, particularly those relating to food and drug adulteration and those pertaining to health and sanitation and should always be ready to co-operate with the proper authorities having charge of the enforcement of the laws.

The Pharmacist should be willing to join in any constructive effort to promote the public welfare and he should share his public and private conduct and deeds so as to entitle him to the respect and confidence of the community in which he practices.

CHAPTER II.

The Duties of the Pharmacist in His Relations to the Physician.

The Pharmacist even when urgently requested so to do should always refuse to prescribe or attempt diagnoses. He should, under such circumstances, refer applicants for medical aid to a reputable, legally qualified physician. In cases of extreme emergency as in accidents or sudden illness on the street in which persons are brought to him pending the arrival of a physician such prompt action should be taken to prevent suffering as is dictated by humanitarian impulses and guided by scientific knowledge and common sense.

The Pharmacist should not, under any circumstances, substitute one article for another, or one make of an article for another in a prescription, without the consent of the physician who wrote it. No essential change should be made in a physician's prescription except such as is warranted by correct pharmaceutical procedure, nor any that will interfere with the obvious intent of the prescriber, as regards therapeutic action.

He should follow the Physician's directions explicitly in the manner of refilling prescriptions, copying the formula upon the label or giving a copy of the prescription to the patient. He should not add any extra directions or caution or poison labels without due regard for the wishes of the prescriber, providing the safety of the patient is not jeopardized.

Whenever there is doubt as to the interpretation of the physician's prescription or directions, he should invariably confer with the physician in order to avoid a possible mistake or an unpleasant situation.

He should never discuss the therapeutic effect of a physician's prescription with a patron or disclose details of composition which the physician has withheld, suggesting to the patient that such details can be properly discussed with the prescriber only.

Where an obvious error or omission in a prescription is detected by the Pharmacist, he should protect the interests of his patron and also the reputation of the physician by conferring confidentially upon the subject, using the utmost caution and delicacy in handling such an important matter.

CHAPTER III.

The Duties of Pharmacists to Each Other and to the Profession at Large.

The Pharmacist should strive to perfect and enlarge his professional knowledge. He should contribute his share toward the scientific progress of his profession and encourage and participate in research, investigation and study.

He should associate himself with pharmaceutical organizations whose aims are compatible with this code of ethics and to whose membership he may be eligible. He should contribute his share of time and energy to carrying on the work of these organizations and promoting their welfare. He should keep himself informed upon professional matters by reading current pharmaceutical and medical literature.

He should perform no act, nor should he be a party to any transactions which will bring discredit to his profession or in any way bring criticism upon it, nor should he unwarrantedly criticise a fellow pharmacist or do anything to diminish the trust reposed in the practitioners of pharmacy.

The Pharmacist should expose any corrupt or dishonest conduct of any member of his profession which comes to his certain knowledge, through those accredited processes provided by the civil laws or the rules and regulations of pharmaceutical organizations, and he should aid in driving the unworthy out of the calling.

He should not allow his name to be used in connection with advertisements or correspondence for furthering the sale of nostrums or accept agencies for such.

He should courteously aid a fellow pharmacist who in an emergency needs supplies. Such transactions had better be made in the form of a sale rather than by borrowing, as is often the custom.

He should not aid any person to evade legal requirements regarding time and experience by carelessly or improperly endorsing or approving statements to which he would not be willing to make affidavit.

He should not undersell a fellow pharmacist for the sake of commercial advantage.

He should not imitate the labels of his competitors or take any other unfair advantage of merited professional or commercial suc-

cess. When a bottle or package of a medicine is brought to him to be refilled, he should remove all other labels and place his own thereon unless the patron requests otherwise.

He should not fill orders which come to him by mistake, being originally intended for a competitor.

He should never request a copy of a prescription from another pharmacist. It is the patient's duty to attend to this if he wishes to make a change in pharmacists.

He should deal fairly with manufacturers and wholesale druggists from whom he purchases his supplies; all goods received in error or excess and all undercharges should be as promptly reported as are shortages and overcharges.

He should earnestly strive to follow all trade regulations and rules, promptly meet all obligations and closely adhere to all contracts and agreements.

It is a question to be decided by each association adopting a code of ethics whether to add a penalizing clause, recommending expulsion for violation. It is doubtful whether such action is advisable. The adoption of a code of ethics or rather the complete fulfilment of all its requirements is a matter which requires time to bring about. Certain sections of the Medical Code of Ethics are openly and continuously violated by physicians in communities where conformity to local custom causes deviation. This, however, does not interfere with the fact that medical ethics as a whole are lived up to by the great majority of practicing physicians and constitute a powerful factor in maintaining the high standing of the members of the profession and the esteem in which they are regarded by the public.

When American pharmacists shall have subscribed to such a code as is outlined above it is believed that the medical societies will co-operate in the formulation of a code of medico-pharmaceutical ethics along the lines of the draft quoted from the Australian association, and both professions, as well as the public, will be benefited by the development of an *entente cordiale* which already exists between thousands of individual members of the two professions, but which has never shown itself in the actions of the organized bodies representing medicine and pharmacy.

There are those in pharmacy who misunderstand what is meant by ethics and think it is something visionary and unattainable and

incompatible with business success. To such I would refer the subject for more earnest and thorough study, and particularly would I ask them to read the following quotation from the address of a prominent medical man discussing the subject at one of our meetings some years ago:

"I have no reproach to cast upon trade. Trade is necessary; trade has built up the country, and will continue to build up the country. Trade has given to the physician and the pharmacist the products of distant lands, which the individual could not get and gather it for himself, and trade and pharmacy are often, on the part of the individual, necessarily associated. But I do quarrel—I have an intense and professional and unending quarrel with those who wish to say that pharmacy is only a trade, and a still more bitter quarrel with those who reply to all questions of justice and progress and truth and honor: 'Oh! that is a matter of ethics and this is a matter of business.'

"Now, my father was a man of business, and I take it as a personal insult to his memory when anybody says that business and ethics cannot be carried on hand in hand; that there is anything whatever in trade and commerce which necessarily imposes falsehood and lying and dishonesty upon man. It is not true, and the men who should resent it most are the men of pure business themselves. The profession of pharmacy and the business of pharmacy and the trade of pharmacy can go along altogether upon the most noble principles and upon the strictest ethics; and unless there is a stringent standard of ethics held by all such associations as this and its branches, and unless that standard is strictly enforced upon all its members, upon the manufacturing firms and upon the individual pharmacists and upon the pharmacists' clerks, upon the professors in the colleges and the authors of textbooks, and the students and all—I say, unless this standard is held up and its rules enforced, then pharmacy as a science is doomed to disappear, and the trade of furnishing drugs will fall to the level of the patent medicine business, and I know of no lower one."

Those who have acted in the spirit of ethical practice have been the greatest contributors to pharmaceutical progress. That spirit can be multiplied many fold if a common ideal of professional and trade procedure is adopted.

The foregoing study has been made in the hope of starting a discussion of the subject that will lead to the adoption, by our own and other associations, of some practical, comprehensive code which will have the support of pharmacists everywhere and which will be a vital factor in the association work of the future.

(*Concluded.*)

MODERN IDEAS RESPECTING ACIDITY AND ALKALINITY.*†

By Norman Evers and J. Gamble.

It is recorded that the Romans were in the habit of testing the alkalinity of their drinking water by titrating it with drops of red wine until the coloring matter was no longer bleached. This must be the earliest use of an indicator. It is primitive in its crudeness, employing a substance of varying acidity for judging alkalinity. Although modern standards are more exact than the wine standard used by the Romans, the modern choice of indicators is often no more logical than the Romans' choice of the coloring matter of red wine.

Probably the earliest conception of an acid presented to our youthful minds was that of a substance which effervesces with a carbonate, though the uses of litmus paper were doubtless instilled into us at almost as early a date. As you all know, a carbonate is a very inefficient means of detecting a weak degree of acidity, since CO_2 is not evolved until the solution is saturated with the gas and not until the solution has reached a comparatively high degree of acidity. Litmus remained for many years practically the only indicator of acidity and alkalinity used by chemists, and litmus paper is still employed to a very large extent. It is, however, in many respects a bad indicator compared with the newer synthetic substances, as we shall see later. Phenolphthalein, methyl orange, and other indicators of less importance have been employed for a number of years, but chiefly in titrations, and hardly even as indicators of reaction in the way that litmus paper is employed. The uses of the indicators now employed for the determination of hydrogen ion concentration are an outcome of the developments of the theory of electrolytic dissociation and of the electrometric methods of determining hydrogen ion concentration. Chemists in early days divided solutions crudely into acid, neutral, and alkaline, and it was not until the ionic theory was developed that the subject was given continuity.

*Read before the meeting of the Pharmaceutical Society of Great Britain.
†Reprinted from the *Pharmaceutical Journal and Pharmacist.*

THE IONIC THEORY.

According to the ionic theory, when hydrochloric acid is dissolved in water it is present only to a very small extent in solutions as molecules of HCl, but is dissociated almost completely into ions of hydrogen and chlorine. The hydrogen ions are, according to modern ideas, atoms of hydrogen which have lost an electron, and so become positively charged, while the chlorine ions have gained an electron and become negatively charged. It is unnecessary for our present purpose to discuss the electrical properties of solutions. It is sufficient at the moment to realize that these ions exist in solutions, and that the acid properties of solutions of hydrochloric acid are entirely due to the hydrogen ions which they contain. We may go further than this and state that the acid properties of all solutions whatever are due solely to the hydrogen ions which they contain. Some acids are only dissociated into ions to a very slight extent; their acid properties are, therefore, slight, and they are known as "weak" acids. Hydrochloric acid and other acids which are almost entirely dissociated in solution producing a high concentration of hydrogen ions are known as "strong" acids. The strength of an acid, therefore, depends entirely on the number of hydrogen ions present in a certain volume of its solution—that is, on the hydrogen ion concentration, not on the amount of acid present. It is important to realize that a distinction must be made between the acidity of a liquid and the amount of acid present. The former depends upon the hydrogen ion concentration, the latter is determined by titration. Similarly bases depend for their properties on the presence of hydroxyl (OH) ions, and the strength of a base depends on the number of hydroxyl ions present in its solutions.

Absolutely pure water is itself ionized to a slight extent into hydrogen and hydroxyl ions; obviously the number of hydrogen ions must in this case be equal to the number of hydroxyl ions, there is an excess of neither. Pure water, therefore, is neutral and has neither acid nor alkaline properties, or perhaps it is truer to state that its acid and alkaline properties are evenly balanced.

Pure water contains about a billion hydrogen ions and a billion hydroxyl ions per litre. It is a 10 millionth normal acid and a 10 millionth normal alkali. Our standard of neutrality is pure water in which there is neither an excess of hydrogen ions nor of hydroxyl ions. Solutions which contain an excess of hydrogen ions

over hydroxyl ions are acid, and those which contain an excess of hydroxyl ions over hydrogen ions are alkaline. Note that it follows from this that all acid solutions, even the strongest, contain hydroxyl ions as well as hydrogen ions, but the latter are in excess, similarly all alkaline solutions contain hydrogen ions in number less than the hydroxyl ions. We may take the analogy of a Congressional constituency, which we call a Republican constituency because it returns a Republican member to Congress. But it does not follow that some Democrats are not to be found there, and though they may be a vanishing quantity in certain places yet there is no place so enlightened or benighted (as the case may be) that their number is zero. We might, therefore, speak of the concentration of Democrats in a Republican constituency. Exactly in the same way we can talk of the hydrogen ion concentration of alkaline solutions. In fact, it is usual to refer to the hydrogen ion concentration of all solutions, acid or alkaline, as it involves the use of one factor only, and the hydroxyl ion concentration can always be calculated from the hydrogen ion concentration. It is usual to express the concentration of solutions in terms of a normal solution, a solution which contains in one litre an amount of the substance corresponding to one gram atom of hydrogen (*i. e.*, 1.008 Gm.). Hydrogen ion concentration may be expressed in the same way; a normal concentration would, therefore, be one gram (more strictly 1.008 Gm.) of hydrogen ions per litre.

Consider the following series of concentrations:

	Hydrogen Ion Concentration			Hydroxyl Ion Concentration
	Normality.	[H]	pH	[OH]
Normal	N/1	$= N/10^0$	0	$N/10^{14}$
Tenth normal	N/10	$= N/10^1$	1	$N/10^{13}$
Hundredth normal ..	N/100	$= N/10^2$	2	$N/10^{12}$
Thousandth normal..	N/1000	$= N/10^3$	3	$N/10^{11}$
Ten-millionth normal (pure water)	N/10,000,000	$= N/10^7$	7	$N/10^7$
Hundred thousand millionth normal ..		$N/10^{11}$	11	$N/10^3$
Hundred billionth normal		$N/10^{14}$	14	N/1

THE VALUE OF pH.

Now the usual method adopted for expressing hydrogen ion concentration is not the rather cumbersome method of normality, but by a value which we know as pH. This value is the power of 10 in the fractions of normality as shown in the above table. Thus we have seen that pure water has a hydrogen ion concentration of one ten-millionth Gm. per litre, or one ten-millionth normal, that is $N/10^7$. The pH of pure water is therefore 7. Similarly, a tenth-normal hydrogen ion concentration, N/10, has a pH of 1, and a hundred thousand millionth normal hydrogen ion concentration, $N/10^{11}$, has a pH of 11. Similarly a fiftieth normal hydrogen ion concentration, N/50, has a pH of 1.7, N/50 being $N/10^{1.7}$.

The points to bear in mind in regard to pH values are: (1) The higher the value of pH the lower is the hydrogen ion concentration, and (2) if the pH is altered by one integer, the hydrogen ion concentration is altered ten times. Solutions having pH values of less than 7 are acid, and those of pH greater than 7 are alkaline. The hydroxyl ion concentration of pOH is obtained by subtracting the pH value from 14.

In much of the work of Pasteur we can trace appreciation of the great influence of the reaction of liquids on enzymes and bacteria. One can see his endeavor to interpret his varying reactions with litmus in relation to an unfixed point of absolute neutrality. As biochemistry developed, the great importance of this factor was clearly seen, and more accurate methods of determination became a necessity. The work of Sorensen at Copenhagen supplied a strong stimulus, and in the realm of physiology the value of his work of elimination and simplification was quickly recognized.

METHOD OF DETERMINING pH.

We pass, then, to the methods of determining hydrogen ion concentration; these are two—the electrometric and the colorimetric. The electrometric method is the more accurate, but it requires expensive and complicated apparatus, and careful attention must be given to detail in order to obtain accurate results. The principle of the method may be outlined. When a piece of metal is dipped into water a small amount of the metal dissolves as metallic ions bearing a positive charge. The metal, therefore, becomes charged negatively with respect to the water. If the solution already contains a

salt of the metal, there is a tendency for the positive metallic ions in solution to separate out on the surface of the metal, causing the metal to become positively charged. The actual difference of electrical potential therefore is the resultant of these two opposing forces, and since the first factor (the solution pressure) is always the same for one and the same metal, the difference of potential due to the second factor is dependent upon the number of metallic ions in the solution. We see, then, that the potential of a metallic electrode in contact with a solution of one of its salts may be used to measure the concentration of metallic ions in the solution. We know that hydrogen behaves in many ways as a metal, and a platinum electrode on the surface of which hydrogen is absorbed behaves as if it were a rod of metallic hydrogen, the solution pressure of platinum itself being practically nil. The difference of potential set up when such an electrode is dipped into an aqueous solution may therefore in a precisely similar manner be used to measure the concentration of hydrogen ions in that solution. The complicated apparatus which is used in this method of determination is therefore employed solely to measure accurately the difference of potential between the hydrogen electrode and the solution, this difference varying with the concentration of hydrogen ions. We pass on to the discussion of the more generally useful method—the colorimetric or indicator method, the data for which are necessarily obtained by comparison with electrometric standards.

An indicator is a substance whose color is affected by the pH of a solution. For example, methyl red has a red color at a pH of 4.4, and in all solutions of greater acidity than this. Above 4.4 the red color gradually changes to a pure yellow at a pH of 6.2, above which no further change occurs. We say, then, that methyl red is an indicator which changes color over a range of pH from 4.4 to 6.2; it will be observed that the change takes place on the acid side of absolute neutrality. Phenolphthalein, with which every one is familiar, changes from colorless to pink from pH 8.3 to 10, that is well on the alkaline side of absolute neutrality. Now if we have a solution whose pH we require to determine which gives a color with methyl red intermediate between these two extremes of red and yellow, we know that its pH lies between 4.4 and 6.2. Further, we can prepare standard solutions of any known pH between these points, and by choosing the standard solution which gives exactly

the same shade of color as our unknown with the same amount of indicator we can thus determine the pH closely.

INDICATORS.

For this method we obviously require a complete series of indicators which change over as wide a range of pH as possible, whose colors are brilliant and contrasting, and show definite changes in shade for a small change of pH. Such a series is shown in the following table:

Indicator.	Color Change.	Range of pH
Thymol blue (acid range)...	Red—yellow	1.2—2.8
Brom-phenol blue	Yellow—blue	2.8—4.6
Methyl red	Red—yellow	4.4—6.0
Brom-cresol purple	Yellow—purple	5.2—6.8
Brom-thymol blue	Yellow—blue	6.0—7.6
Phenol red	Yellow—red	6.8—8.4
Thymol blue (Alkaline range)	Yellow—blue	8.0—9.6
Phenol thymol phthalein	Colorless—pink—violet.	8.3—11
Thymol violet	Yellow—blue—violet ..	9—13

The essentials of a good indicator are:

(1) The color change should be sharp—*i. e.*, the range of pH over which the change occurs should be as short as possible. For hydrogen ion determinations a difference of 0.1 in pH should cause a distinct change of tint in the indicator.

(2) The two end colors of the indicator should form as great a contrast as possible. The change of thymol blue from yellow to blue or brom-cresol purple from yellow to purple is much more easily distinguishable than that of litmus or methyl orange. Unfortunately, the intermediate tints of these indicators with such contrasting colors are not always so satisfactory for pH determinations as those of the yellow-red indicators such as methyl red or phenol red.

(3) The indicator should be affected to the least possible extent by the presence of neutral salts or other compounds.

In all these points the newer indicators, some of which were specially synthesized for the purpose by two American chemists,

Clark and Lubs, have advantages over the old. They cover the complete range from pH 1.0 to pH 13.0.

We are now in a position to examine the defects of litmus as an indicator. (1) The coloring matter of litmus does not consist of a single substance, and its composition depends to a large extent on the method of extraction. (2) Its color change is slow compared with the newer indicators and the colors are not so brilliant. Azolitmin, which is the chief indicating substance present in litmus, changes color from pH 4.5—8.3, a very much larger range than that of the new indicators. (3) It is affected by the presence of salts and proteins. If a certain mixture of acetic acid and sodium acetate having pH 6.25 be diluted once, eight, or sixteen times, the pH value is practically unaffected, but these solutions will all give different shades of color with litmus solution. These defects are all inherent in litmus itself, but when litmus paper is used other sources of error creep in. (1) The time taken for the paper to reach its correct tint varies very considerably with different solutions and according to the paper used. (2) The material of the paper may itself neutralize the acidity or alkalinity of the solution to be tested, and consequently no change will be observed. (3) Certain liquids, such as milk, urine, solutions of phosphates, have been sometimes described as "amphoteric" to litmus—*i. e.*, they are said to turn blue litmus paper red and red litmus paper blue as though they had some remarkable property of being acid and alkaline at the same time. This is not really the case. These liquids are actually solutions of neutral reaction which bring the color of both red and blue litmus to its neutral tint.

It is possible, therefore, to find solutions of exactly the same PH which give quite different indications with the same litmus paper and again different results with other kinds of litmus paper.

BUFFER ACTION.

If we add one drop of weak hydrochloric acid to pure distilled water we probably change its pH by several integers, say, from 7 to 3. If we add the same amount of acid to water containing a little sodium phosphate the change of pH will be very slight indeed. The phosphate exerts what is known as buffer action —*i. e.*, it tends to resist the change of pH on the addition of acid or alkali. Salts of weak polybasic acids such as phosphates, carbonates,

citrates, or borates exert the strongest buffer action. Proteins or amino acids are also good buffers, whilst all salts of weak acids show the property to some extent. The buffer action of salts of strong acids and bases—*e. g.*, sodium chloride—is very slight indeed. This explains why when one is titrating a strong acid with a strong base to an indicator the end point is very sharp, but with weak acids, and especially with polybasic acids such as phosphates, the end point is gradual and difficult to determine. The reason is that the pH is changing more slowly in the latter cases. Buffer action is of the utmost importance in our bodily functions; all physiological fluids show buffer action. The blood is a splendid example of a buffer solution owing to the sodium bicarbonate, proteins, etc., which it contains. It is of very great importance to our bodies that the blood should be kept within certain narrow limits of pH, and were it not for this buffer action a small introduction of acid into the blood stream would raise its pH to such an extent that the symptoms of acidosis would speedily occur. Fortunately, Nature has arranged that the sodium bicarbonate of the blood must be entirely neutralized before the pH rises to a dangerous point, and this only occurs in very abnormal conditions. We may liken the action of buffer salts which prevent changes of hydrogen ion concentration to a thermostat which prevents changes of temperature.

Returning to the indicator method, we said that the essentials are a complete series of indicators and a series of solutions of any known pH. The first requirement has already been dealt with; solutions of standard pH are prepared from salts which show buffer action. If we tried to make solutions of standard pH by using hydrochloric acid, for instance, or any acid or salt which does not show buffer action, we should find that these solutions were so readily affected by the acidity of the air or the alkalinity of the glass container that their pH would quickly be changed, and they would be useless. By using a buffer salt the solutions are comparatively unaffected by outside influences. Sodium phosphate is a good example of such a salt. The pH of a N/15 solution is 9.2. The pH of a solution of potassium acid phosphate of the same strength is 4.5. By mixing different proportions of these solutions we can obtain a solution of any desired pH between these points. Other salts, such as sodium borate or citrate, may be used to obtain solutions of other ranges of pH. Instead of using a number of in-

dicators, each covering a certain pH range, it is often convenient to use a suitable mixture of indicators covering a much wider range. The "compound indicator" shown, which was devised by Mr. J. L. Lizius, B. Sc., A. I. C., will be seen to show color changes through the spectrum from red to violet over the wide range of pH from 4 to 11. Small tablets containing a definite amount of the compound indicator are extremely useful for the approximate determination of pH. One is dropped into 10 cc. of the solution to be tested, and in about a minute it has dissolved, giving a definite color to the solution. According to the shade of color obtained one can write down at once the approximate pH. We are able, therefore, to determine by a simple test as easily applied as the ordinary test with litmus paper—not only whether a solution is acid or alkaline, but also an approximate measure of the degree of acidity or alkalinity. The value of this to the pharmacist or analyst is obvious. Possibly the approximate pH as given by the compound indicator tablets is all that we require, but if a more accurate determination is desired a single indicator whose pH range corresponds with that given by the approximate determination must be chosen. A definite amount of this indicator is added to 10 cc. of the solution to be tested, and the color observed; knowing the range of the indicator, we can judge approximately from the shade of color what the pH is, and we, therefore, prepare 10 cc. of a solution of this pH from our standard buffer solutions, and add to it the same amount of indicator. If the colors match, the pH is that of the standard; if not, fresh standards of different pH must be prepared until the colors exactly match. An accurate determination of pH can thus be made by a method which is simple and easy to carry out, and requires no complicated apparatus.

If the solution to be tested is itself colored we have to adopt a special device to compensate for the original color. This is known as a comparator. It consists of a block of wood with four holes to hold four test tubes, so arranged that one can look through two pairs of tubes simultaneously. In hole No. 1 is placed the tube containing the unknown solution with the indicator. Behind this, in hole No. 2, is a tube containing distilled water. Hole No. 3 contains the original solution without any indicator, and behind this, in hole No. 4, is a tube containing the solution of standard pH with the indicator. On looking through the two pairs of tubes,

therefore, we get in each case the combined color of the solution and the indicator. The former is thus compensated for, and we can vary the standard solution until a perfect match is obtained. There are some solutions, of course, which are too deep in color for examination by this method, and of these the pH can only be determined by the electrometric method; deeply colored solutions can, however, be treated in this way with surprising frequency. Many colored solutions may be considerably diluted before the determination is made. It might seem at first sight that dilution of a solution would cause a considerable alteration in its pH; while this is so with pure solutions of strong, highly dissociated acids, such as hydrochloric acid, there are many solutions, especially buffer solutions, which may be diluted ten or twenty times with scarcely any appreciable change of pH. In the case of weak acids which are only partially dissociated, dilution causes greater dissociation, with corresponding production of hydrogen ions, and consequently the effect of dilution is diminished. In the presence of a salt of the acid in the solution the effect of dilution is still further reduced. In determining the pH by the indicator method the effect of a moderate amount of dilution can, therefore, in most cases be neglected. For example, a normal solution of asparagine has pH 2.95—after tenfold dilution 2.97, and after a hundredfold dilution 3.11. By now the strict utilitarian in the audience is probably asking: "What is the use of all this? Does it matter whether a solution has pH 6 or 7, whether it has a hydrogen ion concentration of one-millionth or one ten-millionth gram per litre? Is this to come into the new curriculum? Of what practical use is it to pharmacists and chemists?"

PRACTICAL APPLICATIONS.

We shall consider some cases where these differences are important, and try to point to some practical applications. The object of this paper will not, however, be achieved unless it interests some here to the point of seeking their own applications.

The vitality of living cells is dependent upon the maintenance of a strictly limited range of hydrogen ion concentration in their environment, and a difference of pH such as that indicated may have a serious effect upon their growth, or even prevent growth altogether. All living cells or organisms, yeasts, moulds, bacteria, etc., have definite ranges of pH within which growth is possible, and one

definite pH at which growth proceeds at a maximum, just as they have an optimum temperature. For example, *B. coli* grows best at pH 5.0, yeast at 2.5. *B. subtilis* can only grow at pH 4.2 to 9.4.

In order that we may grow these organisms in the laboratory, it is, therefore, important that the medium in which they are cultivated should be at the optimum reaction for their growth. Media for the growth of bacteria, yeasts, etc., are, therefore, adjusted to a definite hydrogen ion concentration suitable to the organism to be grown. In this way it may even be possible by choosing the pH of the medium to encourage the growth of one organism and to discourage others.

The hydrogen ion concentration of physiological fluids is remarkably constant, and, as previously mentioned when referring to the buffer action of blood, these fluids are buffered so as to prevent change of pH. The following are a few examples of the pH of body fluids:

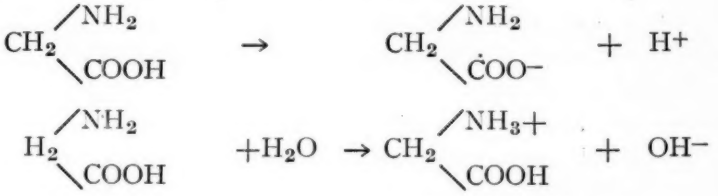
	pH.
Pancreatic juice	8.3
Blood	7.4
Tears	7.2
Human milk	7.1
Saliva	6.9
Cow's milk	6.7
Urine	6.0
Perspiration	4.5
Infant's gastric juice	5.0
Adult gastric juice	0.9—1.6

In the vital processes the hydrogen ions appear not to be directly concerned with the chemical transformations effected, for instance, by the digestive enzymes; they play the part of a conditioning agent like temperature, but their concentration must be within certain limits which differ, for example, in different portions of the digestive tract. Thus, besides an optimum temperature—that of the body—there is for each enzyme an optimum pH as follows:

Enzyme.	Optimum Value of Ph.
Trypsin	8.0
Pepsin	1.4
Invertase	4.5

The optimum pH value agrees approximately with that of the fluids in which their action naturally takes place. Assay work in regard to such enzymes should obviously be conducted under comparative conditions of hydrogen ion concentration, and extraction or purification processes should take this factor into account.

Proteins are able to function both as acids and bases, and are, therefore, known as amphoteric electrolytes or ampholytes. A protein may dissociate into hydrogen ions and negatively charged groups, or into hydroxyl ions and positively charged groups. Taking glycocoll as a simple example of an amino acid, of which proteins are built up, it may be ionized thus:



Glycocoll dissolves in sodium hydroxide to form salts, and in this case—that is, in alkaline solutions—the first dissociation is prominent; in acid solutions it acts as a base, the second dissociation being then most marked. Now, obviously there must be a definite value of pH at which these two dissociations are equal, where the compound is acting as an acid to exactly the same extent as it acts as a base. This point is known as the isoelectric point, and each protein or amino acid has its own individual isoelectric point, for example:

	pH at Isoelectric Point.
Histidine	7.2
Casein	4.6
Gelatin	4.6

At the isoelectric point proteins have certain important properties; solubility is at a minimum; if the substance is a colloid it flocks most readily at its isoelectric point; in the case of gelatin swelling is least marked at this point. These facts have a most important bearing on some industrial processes, for example, the preparation of casein, and their application to pharmaceutical preparations which contain albuminous or colloidal material will be at

once seen. A liquid which is practically unfilterable may be made to filter readily if brought to the right pH.

Enzymes, which, as you know, are proteins, also function as ampholytes. If the hydrogen ion concentration is greater than at the isoelectric point the enzyme exists mainly as kations, whereas if the solution be alkaline to this point the enzyme exists mainly as anions. Now, maltose, trypsin, and erepsin are known to be active only as anions, pepsin as kations, and invertase as undissociated molecules.

Curiously, although undissociated pepsin has no action on ordinary proteins, it has the property of curdling milk. In this connection a most important consideration for pharmacists is the stability of some physiologically active principles under different conditions of hydrogen ion concentration. The infundibular portion of pituitary gland contains two active principles, one of which, known as the "pressor" substance, raises the blood-pressure, the other causing contraction of the uterus. Both principles are rapidly destroyed if the solution is allowed to become alkaline. On the other hand the pressor principle in particular is sensitive to too great a concentration of hydrogen ions. In order, therefore, to maintain the original activity of the gland it is of the utmost importance that extraction should be carried out under definite conditions of hydrogen ion concentration.

Solutions of certain alkaloids, such as cocaine and its derivatives, are known to suffer hydrolysis, with consequent loss of activity if allowed to become alkaline, and cases have been known where the alkalinity of the glass used in ampoules has been sufficient to bring this about. Strophanthin also is rapidly rendered physiologically inert by alkali. Such solutions should be buffered.

The disinfectant or preservative action of acids and bases is in large measure due to the hydrogen or hydroxyl ions, and a study of methods of sterilization and pasteurization would probably show that the effective temperature required depends on the hydrogen ion concentration. If a liquid is acid, a lower temperature would be required to effect sterilization than for one less acid. The preservative effect of hydrogen ions is made use of in the preservation of foods by vinegar. All acid beverages depend for their "sharpness" upon the hydrogen ion content, as the following figures show:

	pH Value.
Lime juice	1.7
Lemon juice	2.2
Wines	2.8—3.8
Orange juice	3.1—4.1
Beers	3.9—4.7
Pear juice	4.2
Grape juice	4.5

The effect of pH on the stability of vitamins has not yet been systematically studied, but there is no doubt that vitamin C, the antiscorbutic vitamin, is rapidly destroyed by alkali, and is only stable in acid media.

Milk straight from the cow has a pH of 6.8, *i. e.*, almost neutral; but with the growth of lactic acid-producing bacilli the pH diminishes until at 6.0 it begins to taste sour. At 4.6 (the isoelectric point of casein) coagulation occurs.

Of interest to the botanist or horticulturist is the hydrogen ion concentration of soils, which differ widely in this respect. Just as in the case of bacteria, different species of plants probably have optimum hydrogen ion concentrations at which they grow best. A correlation has been shown to exist between the natural distribution of plants and the pH of the soil, as well as with the growth of harmful or beneficial micro-organisms. Every gardner knows crudely that when a soil becomes too acid it is less productive and must be treated with lime. These applications apply chiefly to life processes or to products from living material. Some instances may be considered where hydrogen ion determinations are of importance in pharmaceutical practice when dealing with chemicals or galenical preparations.

Every pure salt in solution of definite concentration has a definite pH. The salts formed by the combination of strong acids and bases are practically neutral in solution, and have approximately pH 7.0; salts of strong acids with weak bases give solutions of greater hydrogen ion concentration, so that their solutions are acid, while those of weak acids with strong bases are alkaline. If the salt is absolutely pure, therefore, its solutions should have a definite pH. Any deviation from this pH is caused by an excess of either the acid or the base or some other impurity. In this connection the effects of buffer action must be borne in mind. A very slight amount

of impurity would alter considerably the pH of a solution of sodium chloride, but it would require a considerable amount to cause any alteration in a solution of sodium phosphate. By an approximate determination of the pH of a solution of a chemical substance one can very simply decide whether an excess of acid or alkali is present —a method which is far better and less liable to error than the ordinary tests with litmus paper of the Pharmacopœia. Potassium iodide may be taken as an example. Pure potassium iodide, being a combination of a strong acid and a strong base, should be approximately neutral in solution; the B. P. says neutral or slightly alkaline to litmus. The slightest amount of acidity is likely to lead to discoloration of the salt and its solutions owing to liberation of iodine. The presence of a small amount of alkali prevents this—in fact, for pharmaceutical purposes a little alkali is an advantge. If the pH of a 2 per cent. solution is between 6 and 9 the salt may be considered satisfactory, though it should preferably not be less than 7. Of two samples coming within the B. P. tests, one will make a satisfactory mixture with sodium nitrite, another will not. Pure sodium salicylate in 2 per cent. solution should have a pH of about 7.5, but the best commercial samples never give a pH above 6, and usually it is 4.5 or less. The reason of this is that the manufacturers leave a little free salicylic acid in the salt to prevent discoloration.

The quality of calcium glycerophosphate may be judged by the pH of its solutions. The pH of the pure neutral salt in per cent. solution should be about 9.0, and if we find a soluble salt giving a solution of this pH we may be fairly sure that we have a good article. Many commercial samples are much more acid owing to the presence of the acid salt, which helps the solubility but may cover up other deficiencies. This question of the pH of solutions of glycerophosphates is of the utmost importance when they are used for glycerophosphate syrups.

Many other instances could be given of the value of this method in analytical or research laboratories, in the pharmacy or manufacturing laboratory. We may use it for testing the acidity of gelatin, starches, sulphur, and many other products, and for the alkalinity of soap solutions or drinking water. Quite apart from biochemical investigations, where a difference 0.1 pH may be important, the approximate determination of pH by such means as have been in-

dicated is not only a great advance on the use of litmus paper, but provides us with valuable comparative information which litmus cannot give. May we hope that the pharmacists of the future will think of acidity and alkalinity in terms of hydrogen ion concentration instead of in terms of litmus paper, and that even in the B. P. the more scientific method will be recognized? If this should come about it cannot be without advantage to pharmacy.

SUMMARY.

Methods of determining hydrogen ion concentration distinguish between degree of acidity and amount of acid present.

There is a point of optimum hydrogen ion concentration for biochemical processes, the activities of enzymes, the growth of microorganisms, etc.

In dealing with organized materials the hydrogen ion concentration of the medium is of great importance.

Solutions of pure chemical substances show a definite hydrogen ion concentration which is a valuable indication of purity.

The indicators now available allow pH determinations to be made with considerable speed and accuracy.

In a Pharmacy . . .

These crowded shelves sweep us in dreams away,
To dim barbaric lands of tropic glare;
Low, steaming jungles steeped in twilight gray,
With flowers lifting in the fetid air.

Far islands deep in blue Pacific seas,
With slow surf creaming on the coral strands;
Backgrounded by the ever-swaying trees,
With lure and glamour of the lotus lands.

Moors desolate swept by the sullen gales,
Grim mountains rearing to their icy heights;
Far provinces beyond the lonely trails,
And lands lost in the Northern winter nights.

All these contribute to the precious store,
This treasure trove of health that we survey;
Here in the Pharmacy whose open door,
Affords assistance when the days drift gray.

Philadelphia. Thos. L. Murray

From the Apothecary.

MEDICAL AND PHARMACEUTICAL NOTES

NATURAL VERSUS SYNTHETIC CAMPHOR.—About two years ago efforts were being made to manufacture synthetic camphor, by reason of the embargo that the Japanese Government had placed on the natural product. Monsieur André Dubosc has recently outlined in a very instructive way the mad and victorious struggle in which the Japanese trust became engaged with the European manufacturers. Synthetic camphor proved to be of such a quality as to constitute a dangerous competitor of the products of the distilleries of Formosa. Its use in celluloid, especially, gave perfect results. This being the case, the Japanese trust tried at first to enter into negotiations with the manufacturers of the artificial product, offering to buy, at good prices, their total output, which would have been sold under the Japanese mark. These offers were not accepted, our manufacturers hoping to become the masters of the market. The Japanese trust then began to lower its price so as to undersell synthetic camphor. It commenced to bleed white the forests of Formosa, thus doubling and tripling production. At the same time, through purchases made by its agents in Bordeaux, it succeeded in raising the price of turpentine, which is the base for synthetic camphor. The price of turpentine rose more than 100 per cent., which proved ruinous to our manufacturers. By lowering finally the price of 1 kg. (2.2 pounds) of camphor to 3 francs, with no limitations as to quantity, which price included freight charges to all European and American ports, the Japanese trust succeeded in giving the *coup de grâce* (finishing stroke) to the manufacture of synthetic camphor. The factories closed, having gone into bankruptcy. Their equipment was sold and scattered to the four winds. After allowing sufficient time to elapse; that is, when it appeared that there was no possibility of the manufacturers of synthetic camphor getting on their feet again, the Japanese trust raised its prices to 110 and even 120 francs per kilogram. The present price is around 25 francs.

The world's consumption of camphor, in 1914, was approximately 18 million pounds (8,181,818 kg.), and since the regeneration of camphor forests is slow, it will be seen that there is still a place for synthetic camphor.—(*Journ Amer. Med. Assoc.*)

WHITFIELD'S OINTMENT.—Whitfield's ointment is composed of benzoic acid and salicylic acid incorporated in a petrolatum base. According to Sutton (*Diseases of the Skin*, Edition 4, p. 1018) it consists of:

	Gm.	
Salicylic acid	1	gr. xv
Benzoic acid	2	gr. xxx
Petrolatum	30	℥ i

Goodman (Epidermophytosis Pedum et Manuum, *Arch. Dermat. & Syph.* 3:652 [May] 1921) gives this formula for Whitfield's ointment:

	Gm. or Cc.	
Salicylic acid	1	gr. xv
Benzoic acid	1.6	gr. xxv
Petrolatum	8	ʒ ii
Cocoanut oil	30	℥ i

—(*Journ. Amer. Med. Assoc.*)

EFFECT OF OPIUM ON THE STOMACH.—Opium alkaloids usually increase the acidity of the stomach. Even in cases of extreme hypoacidity, normal acidity in the stomach is brought about with opium. It is shown that there is a distinct difference between hypoacidity and anacidity, for in the presence of anacidity opium does not produce a normal acidity. While opium alkaloids usually raise the acidity, they retard the motility of the stomach. The evacuation time of the stomach is primarily lengthened, independently of the acid conditions. The alkaloids close the pylorus even though there is an anacid condition of the stomach, for the retarded motility associated with increased tonus and active peristalsis cannot be explained in any other way.—L. Jarno and D. Marko (*Wiener Klin. Wochenschr.*, Vienna, October 13, 1921, through *Journ. Amer. Med. Assoc.*, January 14, 1922, 156.)

THE TREATMENT OF CARBON MONOXIDE POISONING.—Carbon monoxide poisoning is one of the most widely distributed and most frequent of industrial accidents, says the U. S. Public Health Service. The gas is without color, odor or taste. It is an ever-present danger about blast and coke furnaces and foundries. It may be found in a building having a leaky furnace or chimney or a gas stove without flue connection, such as a tenement, tailor shop, or boarding house. The exhaust gases of gasoline automobiles contain from 4 to 12 per cent. of carbon monoxide, and in closed garages men are not infrequently found dead beside a running motor. A similar danger may arise from gasoline engines in launches. The gas is formed also in stoke-rooms, in gun turrets on battleships, in petroleum refineries, and in the Leblanc soda process in cement and brick plants. In underground work it may appear as the result of shot firing, mine explosions, or mine fires, or in tunnels from automobile exhausts or from coal or oil burning locomotives.

Carbon monoxide exerts its extremely dangerous action on the body by displacing oxygen from its combination with hemoglobin, the coloring matter of the blood which normally absorbs oxygen from the air in the lungs and delivers it to the different tissues of the body.

Oxygen will replace carbon monoxide in combination with hemoglobin whenever the proportion of oxygen in the lungs is overwhelmingly greater. Therefore:

1. Administer oxygen as quickly as possible, and in as pure form as is obtainable, preferably from a cylinder of oxygen through an inhaler mask.

2. Remove patient from atmosphere containing carbon monoxide.

3. If breathing is feeble, at once start artificial respiration by the prone posture method.

4. Keep the victim flat, quiet and warm.

5. Afterwards give plenty of rest.

LABORATORY WORKERS CONTRACT TULARÆMIA.—All six of the laboratory workers of the U. S. Public Health Service, who have been studying tularæmia, a disabling sickness of man which has been known, particularly in Utah, for the last five years, have con-

tracted the disease, two of them being infected in the laboratory in Utah and the other four in the Hygienic Laboratory in Washington. Such a record of morbidity among investigators of a disease is probably unique in the history of experimental medicine.

Two of these workers are physicians; one is a highly trained scientist; and the others are experienced laboratory assistants. One of them contracted the disease twice, once in the laboratory in Utah and again, two years and five months later, in the laboratory in Washington.

In these workers the disease began with a high fever, lasting about three weeks, and was followed by two months of convalescence. The disease has few fatalities, its chief interest arising from the long period of illness which it causes in midsummer, when the farmers of Utah are busily engaged in cutting alfalfa and plowing sugar beets.

The studies into the cause and transmission of the disease show it to be due to a germ, *Bacterium tularense,* which is conveyed by six different insects: the blood-sucking fly, *Chrysops distalis;* the stable fly, *Stomyox calcitrans;* the bedbug, *Cimex lectularius;* the squirred flea, *Ceratophyllus acutus;* the rabbit louse, *Hæmodipsus ventricosus;* and the mouse louse, *Polyplax serratus.* Only the first four of these are known to bite man. It appears possible that the germ may also enter through unbroken skin; for instance, that of the hands.

SCIENTIFIC AND TECHNICAL ABSTRACTS

INCREASED TRADE IN CAMPHOR.—During the past five years exports of camphor from China have shown a steady increase. Whereas, camphor exports in 1919 amounted to 316,933 pounds, valued at $150,489, the Chinese exports of this article in 1919 amounted to 3,079,066 pounds, worth 2,168,030, and further increased to 3,999,600 pounds, valued at $3,493,252, in 1920. In regard to the camphor trade of China, the Chinese Maritime Customs Returns says:

Formosa has a virtual monopoly of the world's camphor supplies, although the quantities arriving from that quarter are gradually diminishing. The principal producing districts in China are the Kiangsi, Fukien, and Kwangsi Provinces, but the crude system of Chinese distillation cannot yet compete with the up-to-date methods employed in Formosa, while the Chinese practice of cutting down the trees without planting new ones will soon kill this industry unless reforestation is attended to. Prices for camphor and camphor oil have greatly increased in recent years, and, as the future of the trade looks hopeful, there should be sufficient inducement to take the necessary steps for the encouragement of this valuable industry.

FORMALDEHYDE IN URINE.—Dr. E. Pittarelli proposes the following test for formaldehyde in urine: To 25 to 30 mils of the urine (acidulated, if not already acid) add 10 to 12 drops of a 1 per cent. solution of phenylhydrazine and heat the mixture to boiling. After a few minutes add 5 to 6 drops of 1 per cent. solution of monomethyl-paramidiphenol sulphate (photol) and 3 to 4 drops of a 25 per cent. solution of caustic soda when a crimson coloration develops; on now adding a magnesium salt a decided purple coloration develops. The crimson color is still visible in a 1:100000 solution of formaldehyde, while the purple color is observable in even still weaker solutions.—(*Merck's Report.*)

BLOOD TEST IN DIABETES MELLITUS.—Williamson describes a test for blood sugar. Twenty cmm. blood are mixed with 1 cc. of a 1:6,000 aqueous solution of methylene blue and 40 cmm. liquor potassæ. The mixture has a deep, definite blue or bluish green color. The tube containing the mixture is placed in a water bath, and the water kept boiling for four minutes. If the blood sugar is decidedly increased, the blue color of the mixture will change to brownish yellow (almost the color of normal urine). When the blood sugar is not increased the mixture tube retains its blue or bluish green color. —(*Journ. Amer. Med. Assoc.*)

ESTIMATION OF ACETONE.—The accuracy of the iodoform method for estimating acetone in aqueous solution depends on the amount of potassium hydroxide added. With either an excess or a deficiency of the hydroxide quantitative results are not obtainable even after standing. If the volume of the aqueous acetone is 20 cc., 10-15 cc. of 3 N/2 potassium hydroxide must be taken, and the reaction is then complete in two minutes. For 100 cc. of acetone solution, 25 to 30 cc. of the hydroxide must be added, and the time of reaction is three to five minutes. In two experiments with absolute acetone in aqueous solution, the results obtained were correct within 0.1 and 0.5 per cent. respectively.—Hermans (*Chem. Weekblad*, 1921, 18, 348, through *J. S. C. I.*, 1921, p. 488).

DETERMINATION OF SUGAR IN URINE.—In the method devised by Benedict and Osterberg the urine is diluted so that the specific gravity does not exceed 1.030. Fifteen cc. is treated with about 1 gm. bone-black (smaller quantities of both may be used if desired). The mixture is shaken vigorously occasionally for from five to ten minutes, and then filtered through a small dry filter into a dry flask or beaker. From 1 to 2 cc. of the urine filtrate is measured into a test tube which is graduated at 25 cc., and if the volume used was less than 3 cc. enough water is added to make the volume exactly 3 cc. Then exactly 1 cc. of 0.6 per cent. picric acid solution (best prepared from dry picric acid) and 0.5 cc. of 5 per cent. sodium hydroxid solution are added. Just before the tube is ready to be placed in boiling water 5 drops of 50 per cent. acetone (this should be prepared fresh every day or two by diluting some pure acetone with an equal volume of water) is added taking care that the drops fall into the solution and not on the sides of the tube. The tube is shaken gently to mix the contents, and placed immediately in boiling water for from twelve to fifteen minutes. The standard solution is simultaneously prepared by treating 3 cc. of pure glucose solution (containing 1 mg. of the sugar) exactly as described for the unknown solution and heating simultaneously. The pure glucose solution containing 1 mg.. of the sugar in 3 cc. of solution will keep indefinitely if preserved with a little toluene. The authors have not been able to find a colored solution which matches the colored product of the reaction and which is permanent.—(*Journ. Biol. Chem.*, through *Journ. Amer. Med Assoc.*)

SYNTHETIC GASOLINE.—A German process for making gasoline, called the Burgess process, has been developed by the originators of the Haber process for the fixation of atmospheric nitrogen by combining it with hydrogen. In carrying out this process hydrogen is passed over carbon at 200 atmospheres pressure and at a temperature of 700° C., whereby hydrocarbons are formed. It is stated that the process has been examined by an American engineer, who has reported that the method is in actual operation and is producing motor fuel on a small scale. If this process should succeed in competing with gasoline from petroleum it would be of great industrial importance. From *Journ. Indus. Eng. Chem.* 14, 165, through *Amer. Jour. of Science.*—(H. L. W.)

THYMOL, MENTHOL AND MENTHONE FROM EUCALYPTUS OILS.—The genus *Eucalyptus* includes numerous species, Australasian in origin, some of which are among the tallest trees in the world. Their leaves contain volatile oils of complex composition. In many species a crystallizable phenol is present, but it is not thymol. A study of the oil from *E. dives,* known locally as the "broad-leaved peppermint," has been made by Smith and Penfold, of the Technological Museum of Sydney, N. S. W., the results of which appear in *Jour. Roy. Soc. N. S. W.,* for 1920 (vol. 41).

That the leaves of certain species of Eucalyptus have an odor resembling peppermint was noticed by the early settlers. Baker and Smith first isolated the constituent to which the odor is due and found it to be a ketone. They called it "piperitone." From the *E. dives,* the yield is, at some seasons, over 3 per cent. As this species is one of the most abundant of the genus a rich source of the ketone is available. The remainder of the oil is mostly phellandrene, which is now recognized as one of the most serviceable materials for flotation work and has other uses.

Thymol can be obtained from piperitone by comparatively simple operations, and menthone is also easily obtained by reduction, from which menthol can be produced by further reduction. Piperitone is normally levorotatory, as is also the corresponding alcohol, piperitol, but readily passes into a racemic form if heated to its boiling point under certain conditions. The piperitone originally obtained was inactive because it had been distilled under atmospheric

pressure, but when distilled under very low pressure the tendency to racemation is overcome. Piperitone combines with sodium acid sulphite without much difficulty, but the compound is soluble in the aqueous solution, but on standing several days a crystalline mass separates from which the pure substance can be recovered.

The authors of the paper describe the production of thymol, menthone and menthol from pure piperitone. The yield of thymol was 25 per cent. of the original material, but it is believed that improvements are possible by which the amount required by theory can be produced. The thymol obtained responded to the standard tests for that substance. To obtain menthone, piperitone was subjected for six hours, at a temperature ranging from 175° to 180° C., to the action of purified hydrogen in presence of a nickel catalyst. The double bond was readily opened out with formation of menthone, but the carbonyl group was not affected even after two days' action. Under correct conditions, however, the reduction to menthol will take place. Sodium amalgam or sodium cannot be satisfactorily applied in these procedures, because a solid bi-molecular ketone is promptly produced. The yield of menthone by the process above noted was almost theoretical, and it responded to the tests for that substance. Any unchanged piperitone can be removed by the action of sodium sulphite.

Menthol was obtained by heating the reduction product from piperitone at from 170° to 180° C. for two hours with an equal weight of phthalic anhydride, dissolving the melt in sodium hydroxide, and removing the small quantity of menthone by ether. The phthalic acid compound was regenerated by treatment with dilute hydrochloric acid, the phthalic ester decomposed by boiling with alcoholic potassium hydroxide, and the menthol separated and crystallized. The odor was excellent, but the product was optically inactive, as is usual with synthetically prepared substances. A separation of the two components is, however, possible.—(H. L.)

SOLID EXTRACTS

About twenty kinds of flies frequent houses. Practically all of them are potential carriers of disease.

It is believed that shellfish and fish are responsible for the bulk of London typhoid fever during the past twenty-five years.

"If a few rows of squashes are planted in cucumber and cantaloupe fields, the moths that lay the pickle-worm eggs will attack the squashes and not the other fruits." But the horticulturist must beware of a cross-fertilization, particularly inasmuch as the squash is very fond of mating with the cantaloupe.

Alterations in ancient Greek manuscripts were so common and so easily made that Democrates composed his book of medicaments in metrical form so that there might be no change made in numbers or words. A translation made with a desperate sprinkling of poetic license follows:

Master, Master,
Use a plaster,
Powdered rice and alabaster,
Turpentine and oil of wine,
Gin and oil of castor.

Twice the usual mileage could be obtained if a tellurium compound were added to the gasoline and motors were charged to higher compression.

Recent research seemingly shows conclusively that endemic goiter is due to deficient supply of iodin in drinking water.

Vitamines have recently been found to stimulate the growth of certain molds. Other molds are either able to do without them or else are able to manufacture them for themselves.

Lead may be too pure for practical purposes. Roofing made of commercial lead, 99.9 per cent. pure, is too soft and when on a steep roof has a tendency to flow downward under its own weight and the heat of the sun.

The Mulford exploration party, now in South America, has secured photographs in Bolivia of what is considered to be the largest tree cactus in the world. It has a limb spread of forty feet or more.

From twenty to twenty-five gallons of 95 per cent. alcohol can be obtained from a ton of dry coniferous wood, such as Douglas fir or Southern yellow pine.

"Electron" is not only a name for the divisions of the atom but also for an alloy consisting of 95 per cent. magnesium, 4½ per cent. zinc and ½ per cent. copper.

A patient was admitted into a Philadelphia hospital recently who had almost exhausted himself with hiccoughing over a period of five days. He was permanently cured by being partially anæsthetized with ether, administered in the usual way.

The white cell of the blood is endowed with hypnotic powers over certain parasites. It is said that the Hæmogregarina Stepanovi becomes paralyzed when it comes in contact with a leukocyte. Its wavy motion stops and it places itself in a stiff position, mesmerized into inactivity. It is then promptly gobbled up by the white cell. This parasite infests reptile blood.

What is the color of pure elemental iron?
Brown? No!
Rusty yellow? No!
Guess again!! No, sir! its color is a silver white!!!

The only way to disarm a poisonous snake is to kill it. Removing the fangs only affords an opportunity for others to grow quickly into their place. In fact a number of small half-grown fangs are always waiting, ready to be developed.

NEWS ITEMS AND PERSONAL NOTES

Professor Cook, with Mr. Cliffe, a member of the Board of Trustees, attended the conference of representatives of pharmaceutical bodies, which recently met at Washington to discuss the alcohol question.

The tenth lecture of the popular series was delivered by Ivor Griffith, on the subject, "One Drop of Blood." A large audience, constituted in part of hospital technicians and internes, attested to the value and interest of this type of instruction. Dean LaWall is next on the program with his "Foods of the Next Century" lecture, which is certain to be of interest, particularly to those who "can eat in any language."

The Alpha Sigma, Chemistry Organization, is proud of its scientific record. It does not satisfy itself with Smokers and Dances, but prefers to hold meetings which afford some mental nourishment. Each month alumni members address the society on some technical chemical topic and the meetings are well attended.

Adley B. Nichols, Instructor in Operative Pharmacy, recently attended the Grand Council meeting of the Phi Delta Chi Fraternity in session at Kansas City, Mo. Mr. Nichols takes an active interest in the affairs of this body, which may account for the strength of this College's chapter of that famous fraternity.

The Freshman class gave a Reception and Dance to the Senior class at the LuLu Temple, evening of February 20th. As usual the Freshmen were on hand in gay numbers, but the Seniors were not quite so plentiful. They do say that Professor Youngken was giving his examination the next day. And of course that "is another story."

Founders' Day Celebration, which occurred February 23, 1922, bids fair to be an annual occurrence. A varied program, which consisted in part of speeches by a number of prominent educators and physicians, entertained quite a large gathering of Philadelphia pharmacists and others interested in the College. Dean Bradley, of the Massachusetts College of Pharmacy, was one of the speakers of the evening.

President Braisted was the principal guest of the Kiwanis Club at one of its recent functions; and the brilliant address which he made on this occasion made a deep impression upon his audience. He spoke of the plans for the new and enlarged college, and the visions which he had for making it a centre of pharmaceutic and medical research.

The monthly meetings of the faculty continue with regularity. The Engineers' Club is the accustomed meeting place, and after the dinner, usually well selected and prepared, comes the menu of mental calories. At the March meeting following a well-chosen dinner of pasteurized potatoes and par-boiled spinach, Dr. Horn, professor of physical chemistry, spoke exhaustively on the subject of Vitamines. It was one of the keen, analytical and systematic presentations, which Dr. Horn knows how well to deliver.

The annual dance of the Phi Delta Chi Fraternity was held Thursday evening, March 16, at the Belmont Country Club. It proved to be the biggest social function of the College year.

The American Pharmaceutical Association has available a sum amounting to $360 which will be expended after October 1, 1922, for the encouragement of research.

Investigators desiring financial aid in their work will communicate before June 1st, with Prof. H. V. Arny, Chairman A. Ph. A. Research Committee, 115 West 68th Street, New York, giving their past record and outlining the particular line of work for which the aid is desired.